



# Bacterial Parasite Communities of the Fossorial Water Vole *Arvicola terrestris* During a Period of High Abundance: Richness and Similarity in a Dynamic World

Petra Villette, Eve Afonso, Geoffroy Couval, Aurélien Levret, Jean-François Cosson, Patrick Giraudoux

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**HAL Id: hal-01870903**

**<https://hal.science/hal-01870903>**

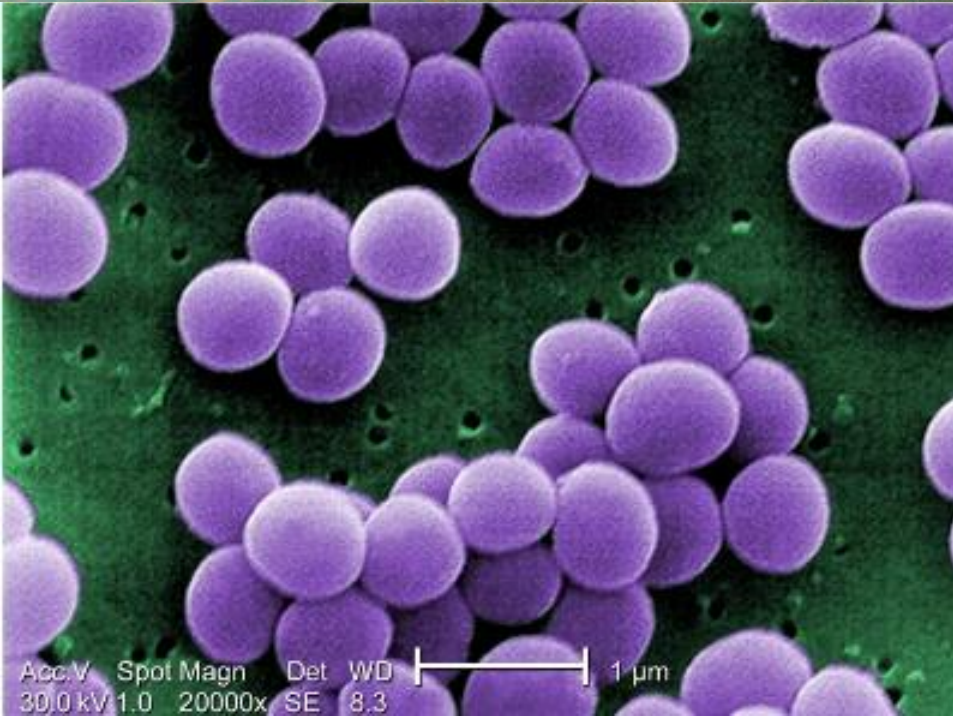
Submitted on 10 Sep 2018

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# Bacterial Parasite Communities of the Fossorial Water Vole *Arvicola terrestris* during a period of high abundance: richness and similarity in a dynamic world

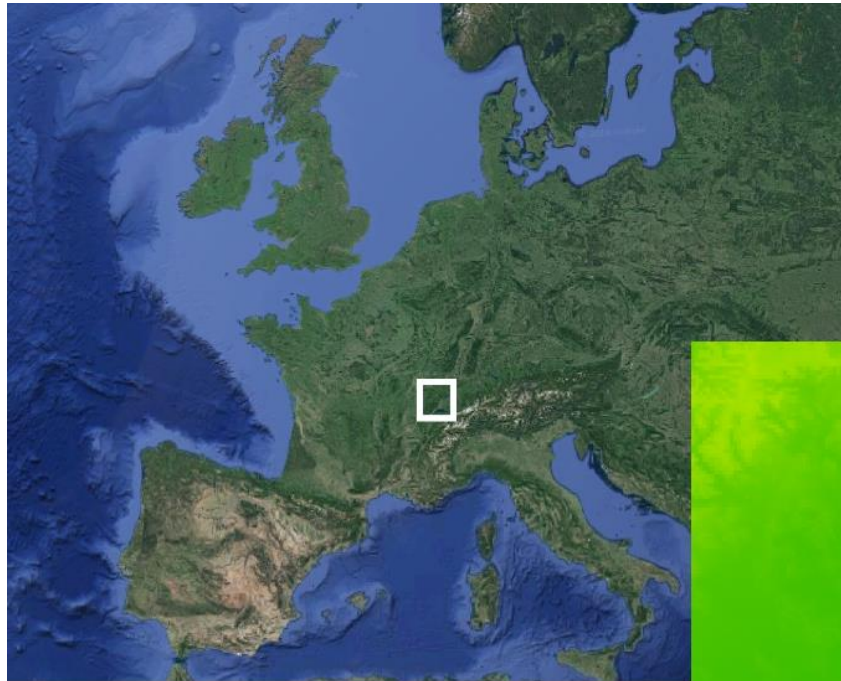


Petra Villette, Eve Afonso,  
Geoffroy Couval,  
Aurélien Levret, Jean-François  
Cosson, Patrick Giraudoux

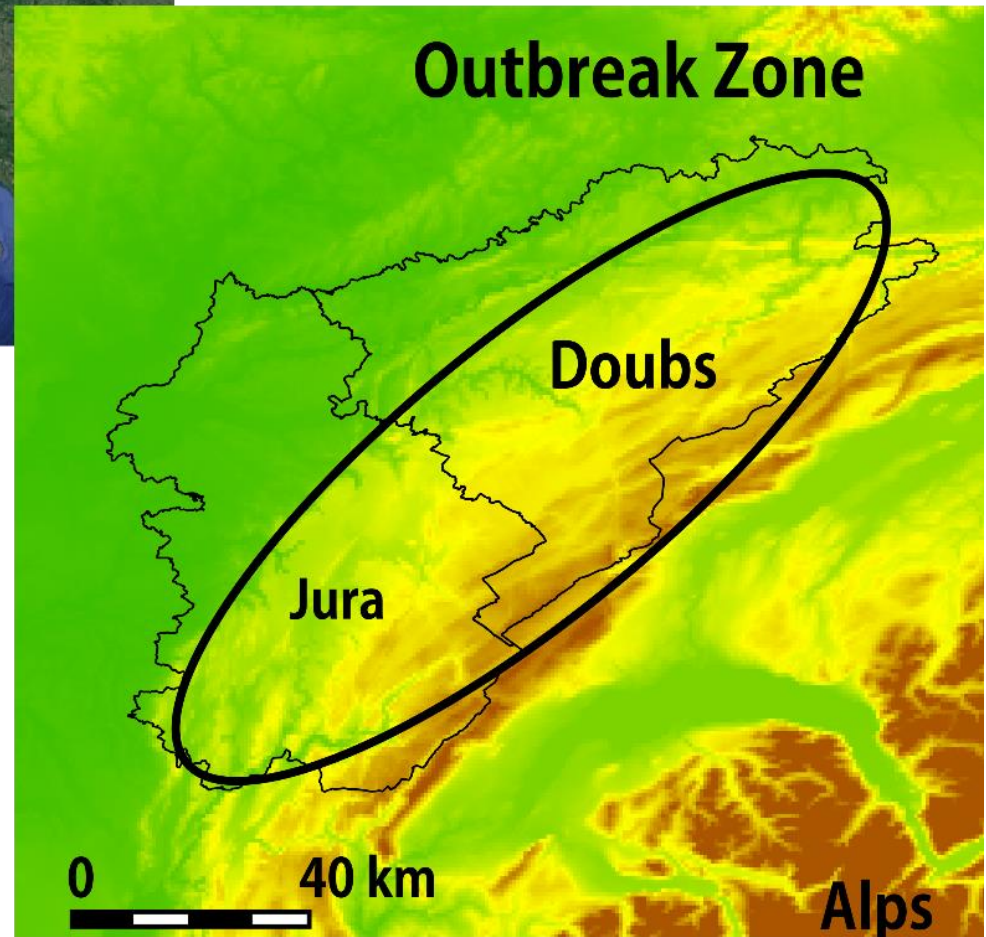




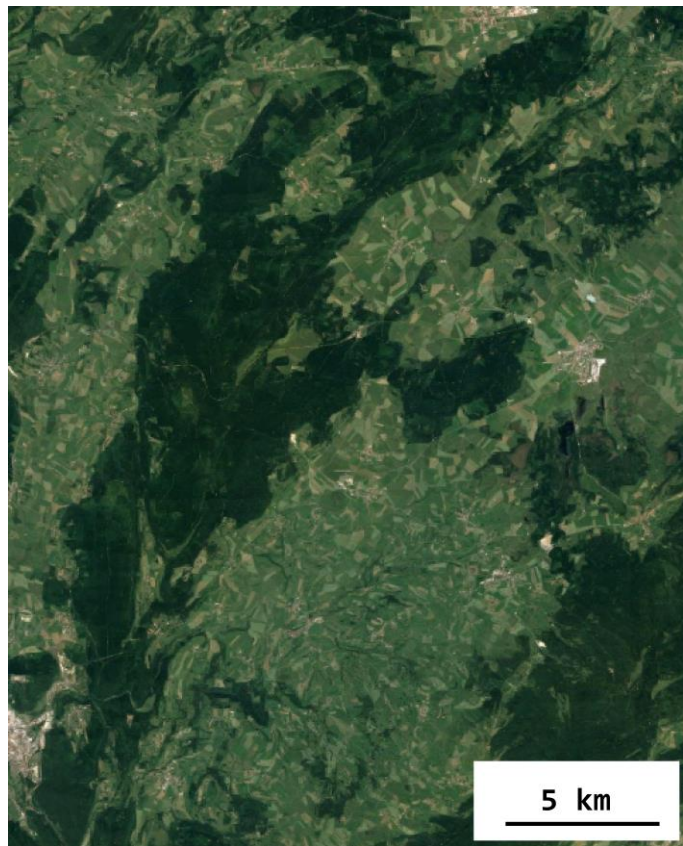
# *Arvicola terrestris* in Franche-Comté



<1500m  
750m  
0m

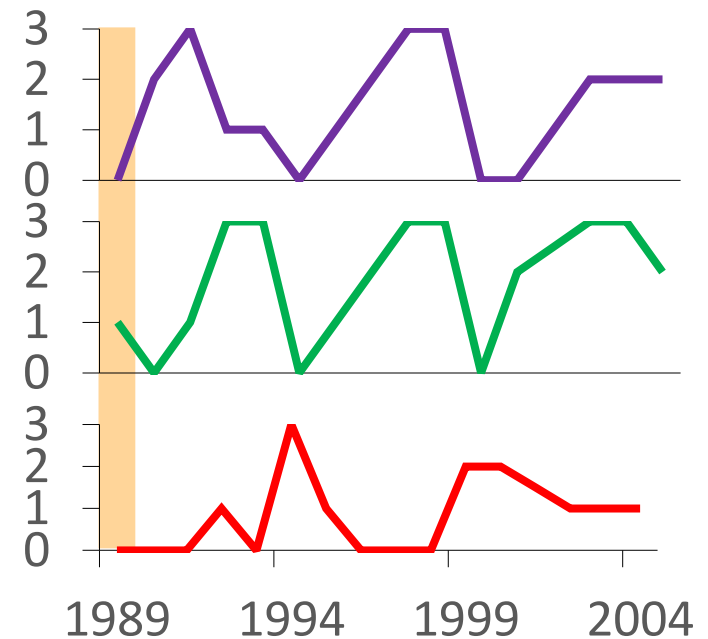
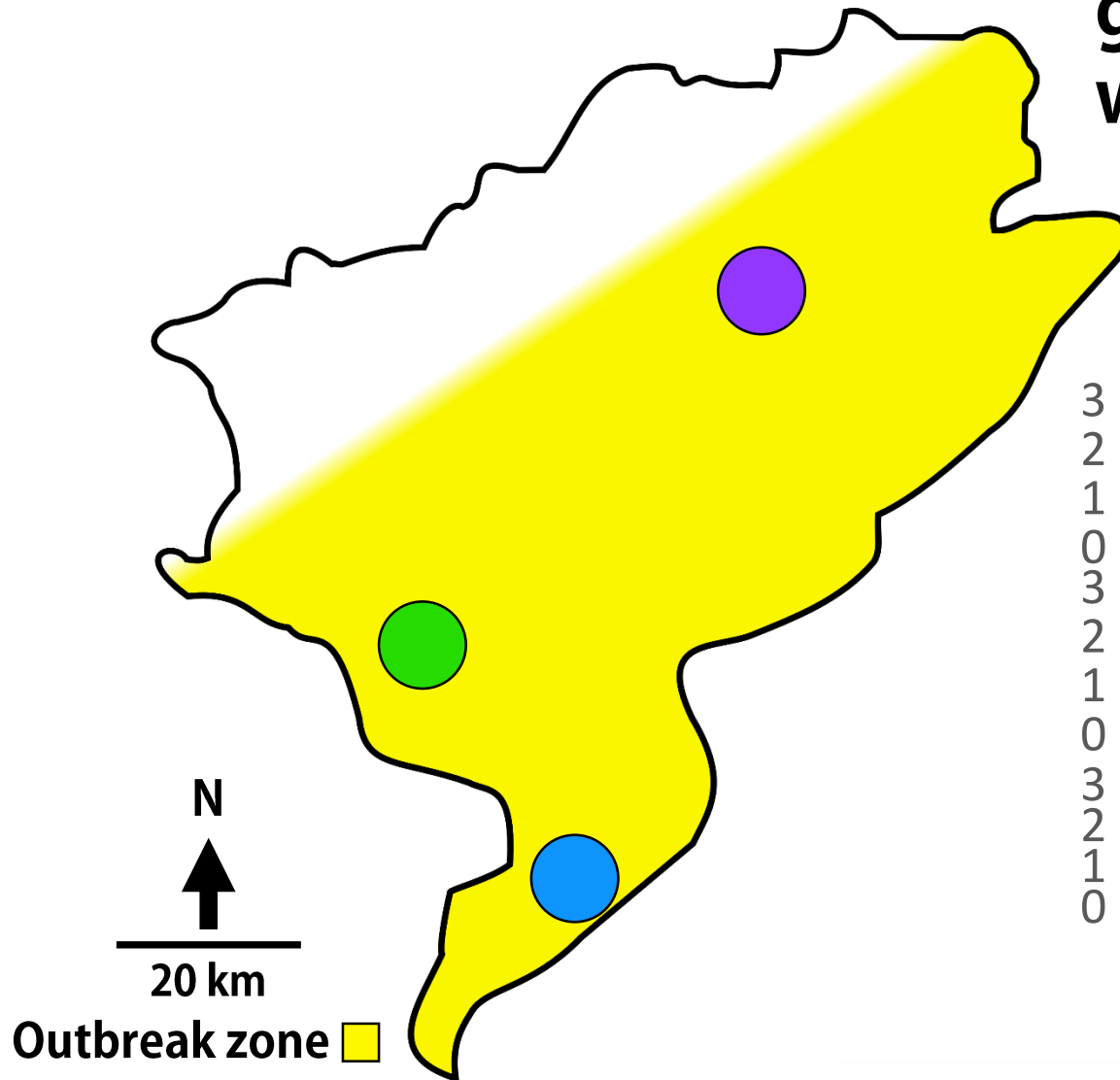






# Spatial Dynamics

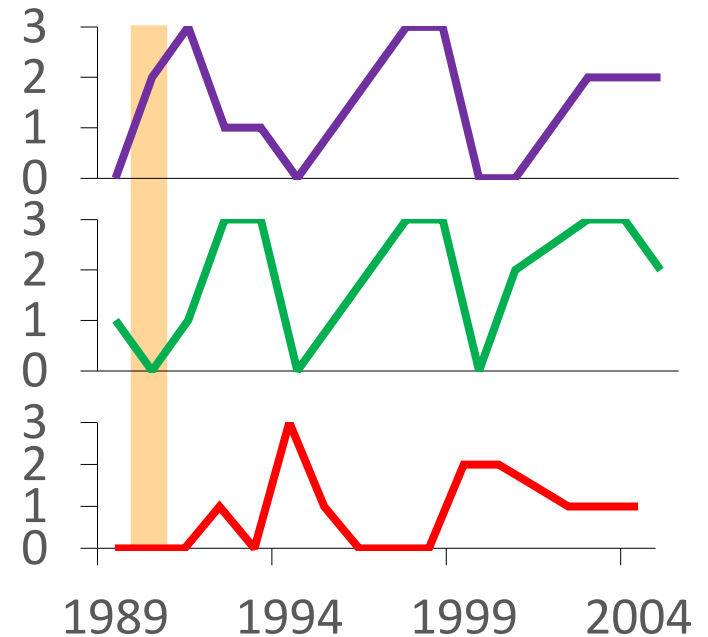
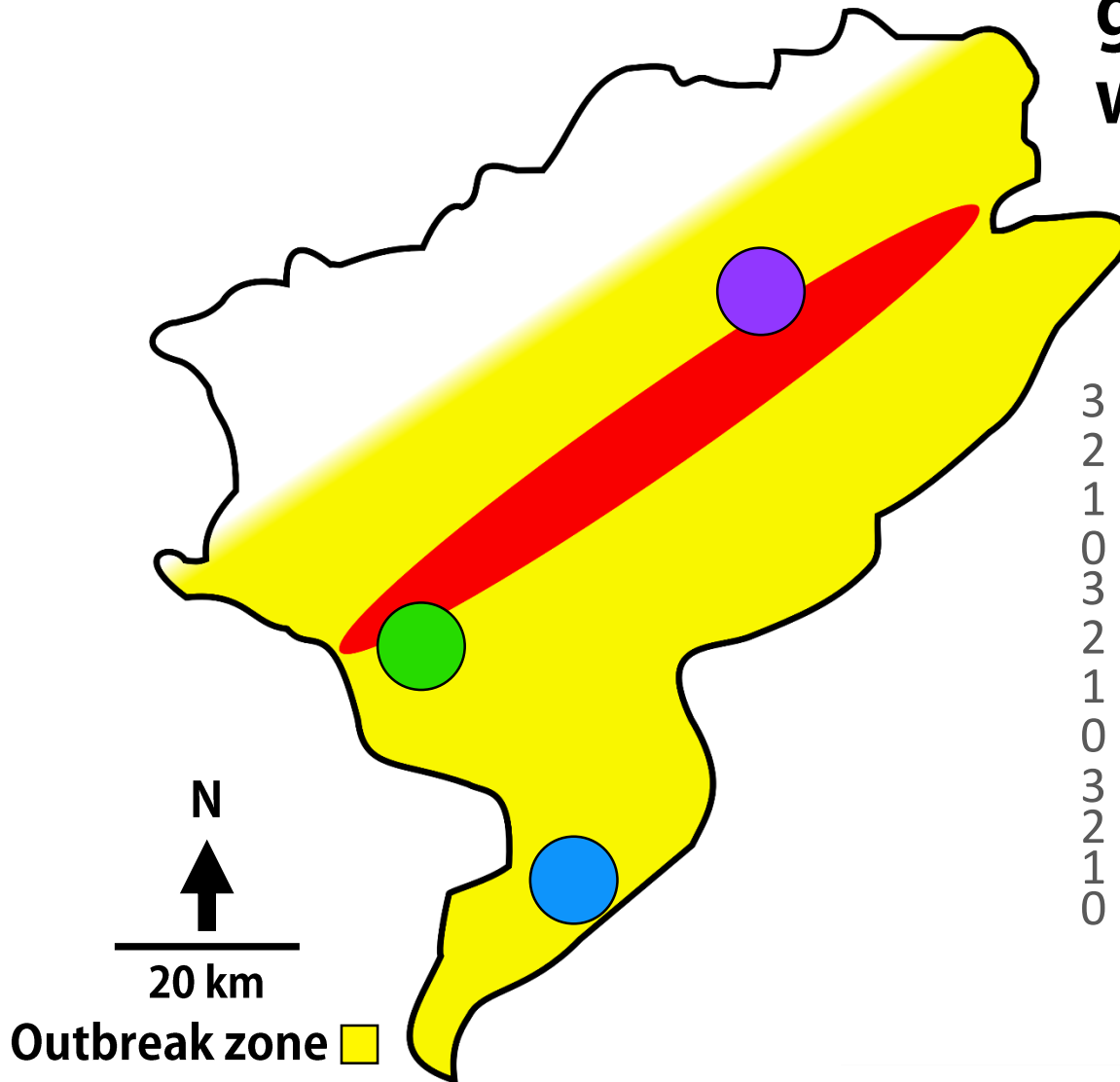
Lagged synchrony  
generates travelling  
wave



(Berthier et al 2014)

# Spatial Dynamics

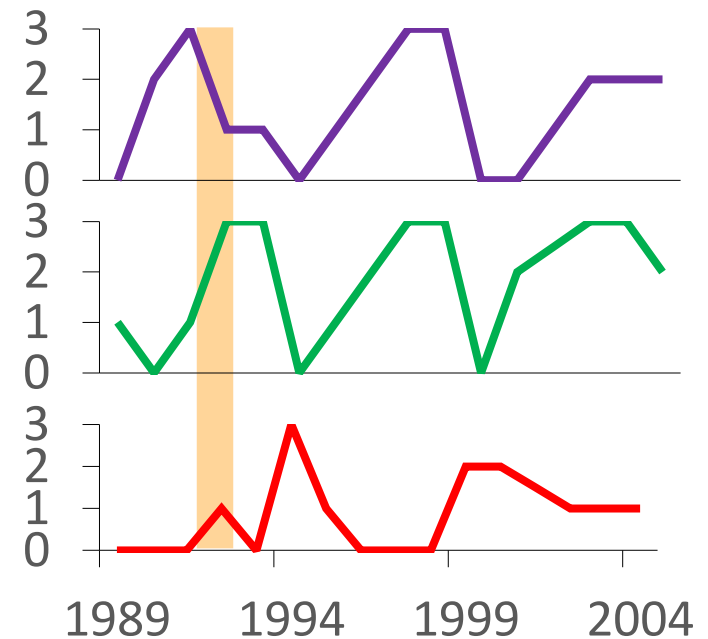
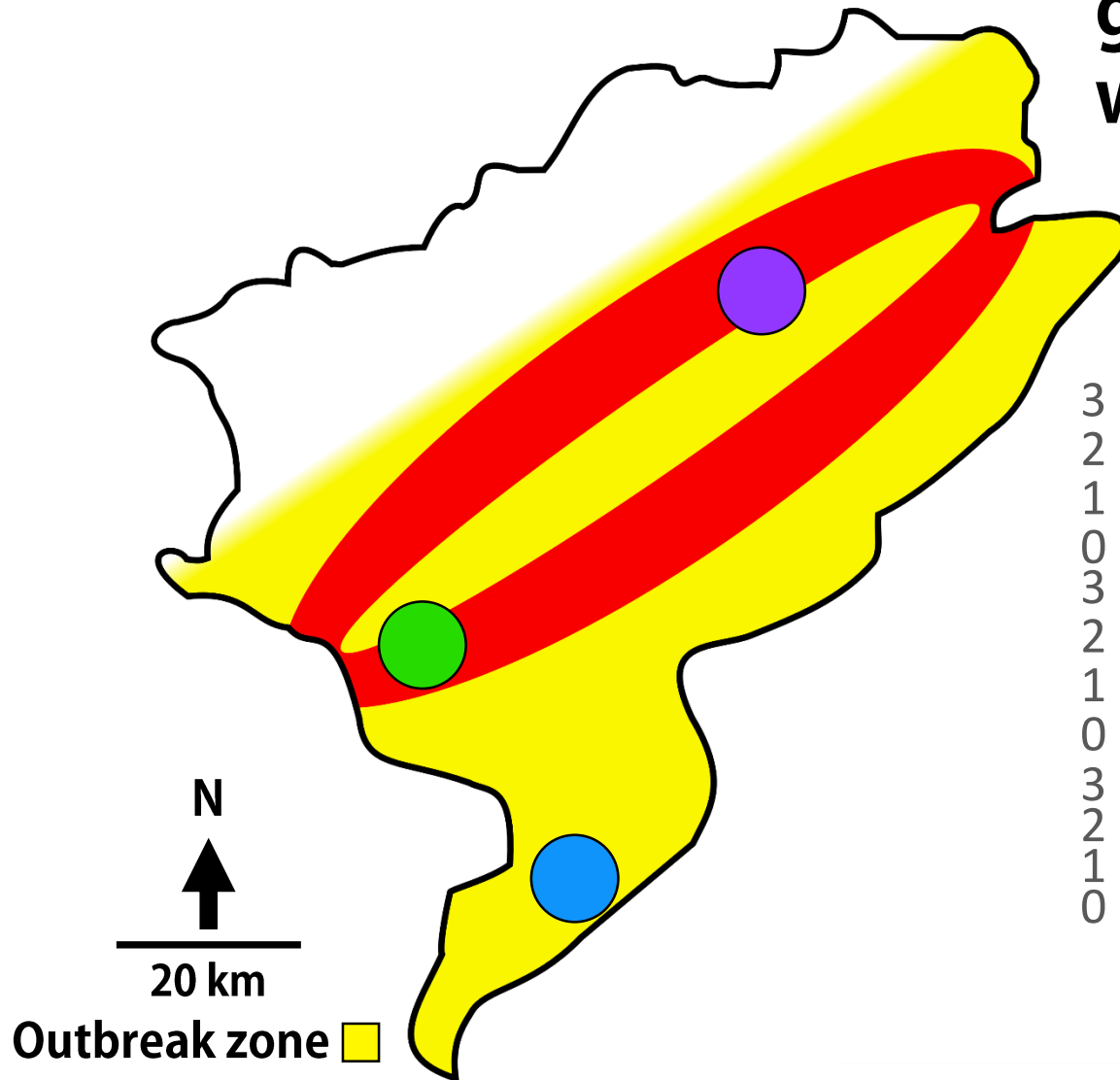
Lagged synchrony  
generates travelling  
wave



(Berthier et al 2014)

# Spatial Dynamics

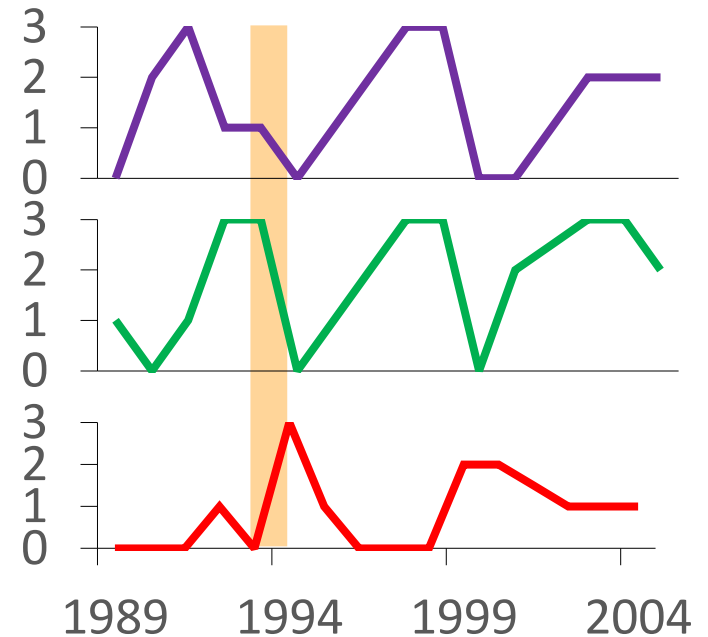
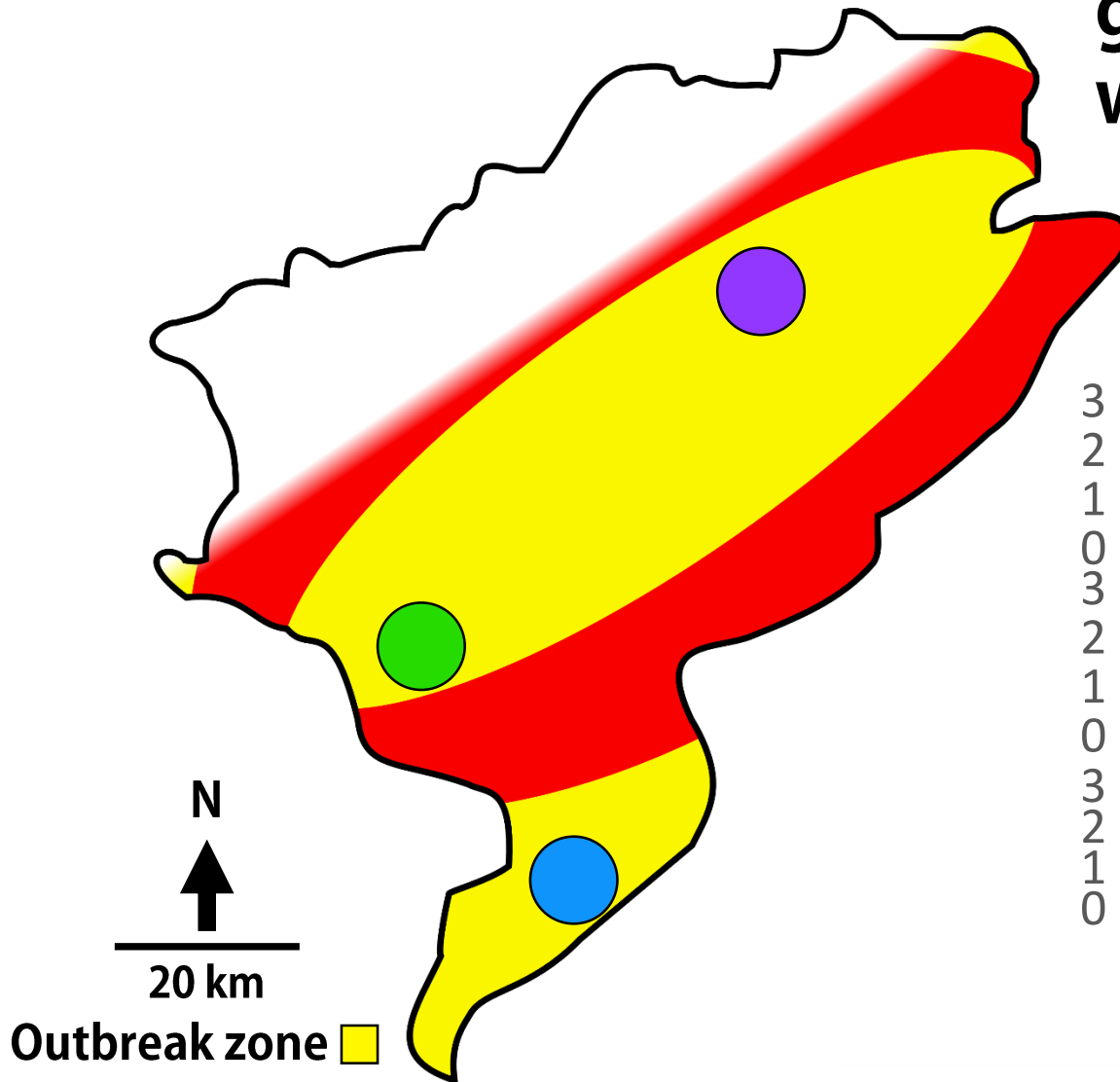
Lagged synchrony  
generates travelling  
wave



(Berthier et al 2014)

# Spatial Dynamics

Lagged synchrony  
generates travelling  
wave

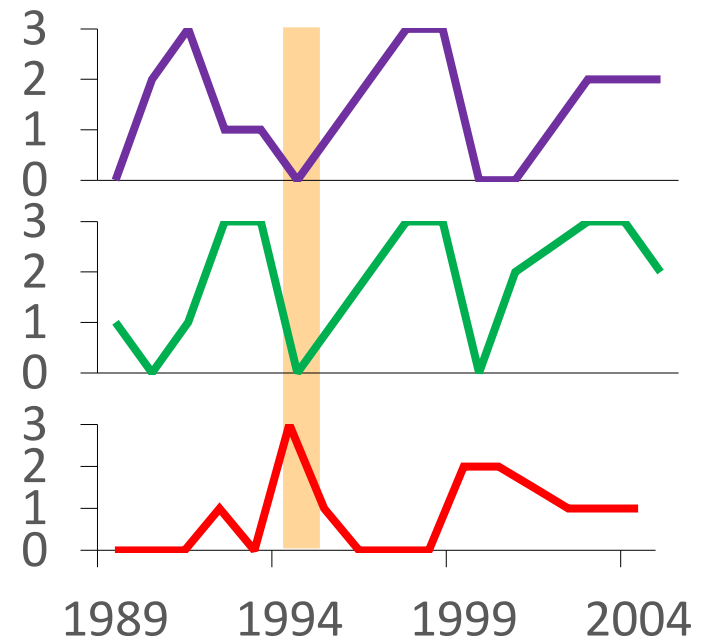
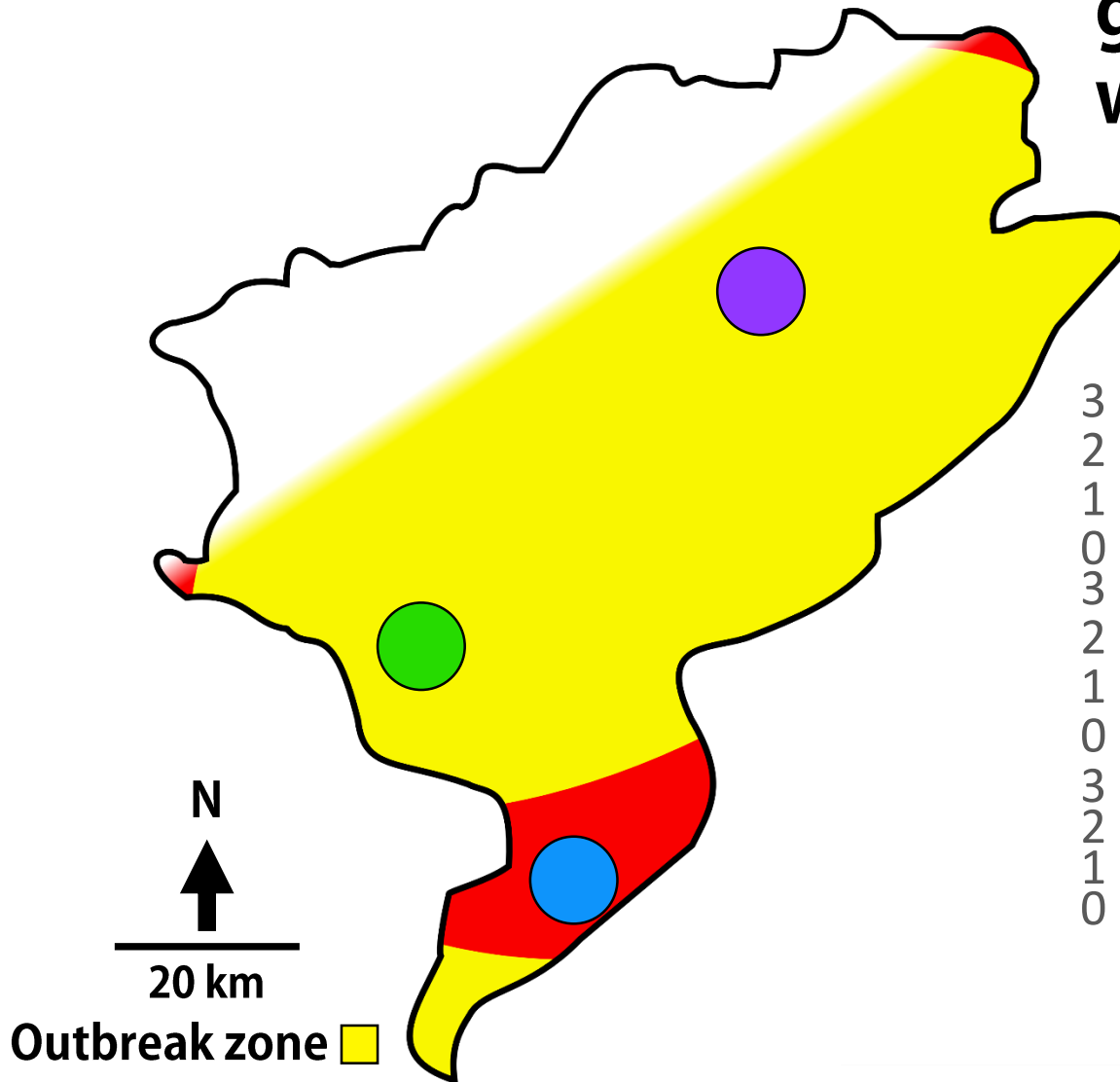


(Berthier et al 2014)



# Spatial Dynamics

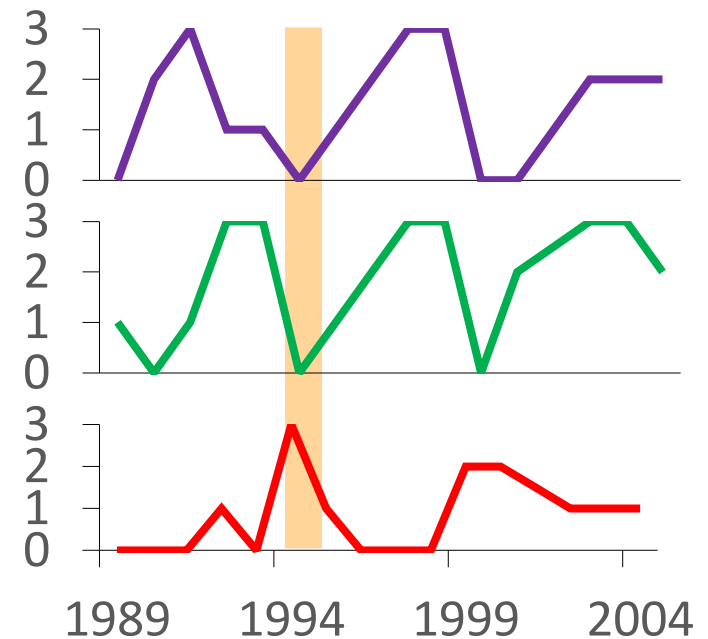
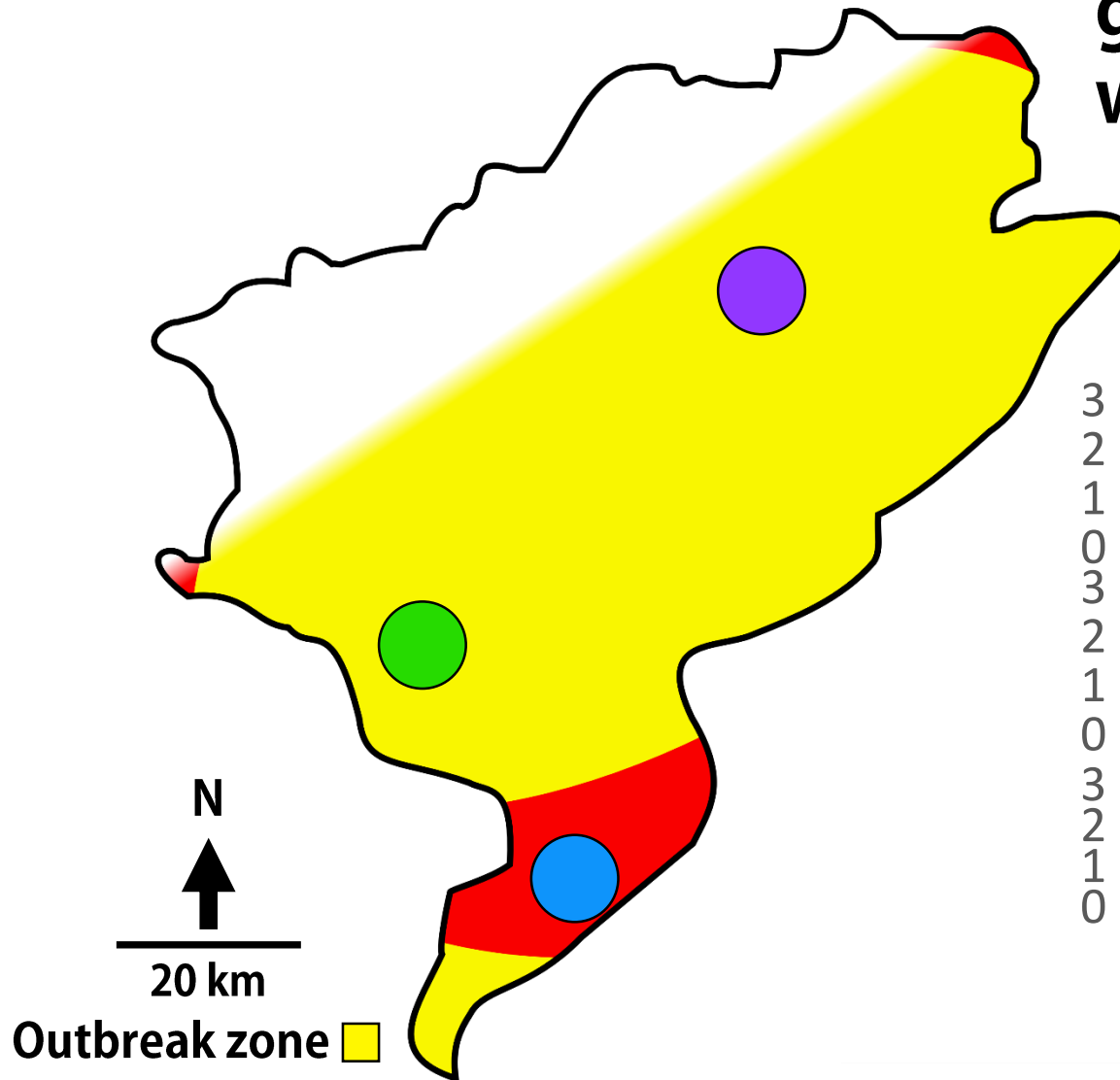
Lagged synchrony  
generates travelling  
wave



(Berthier et al 2014)

# Spatial Dynamics

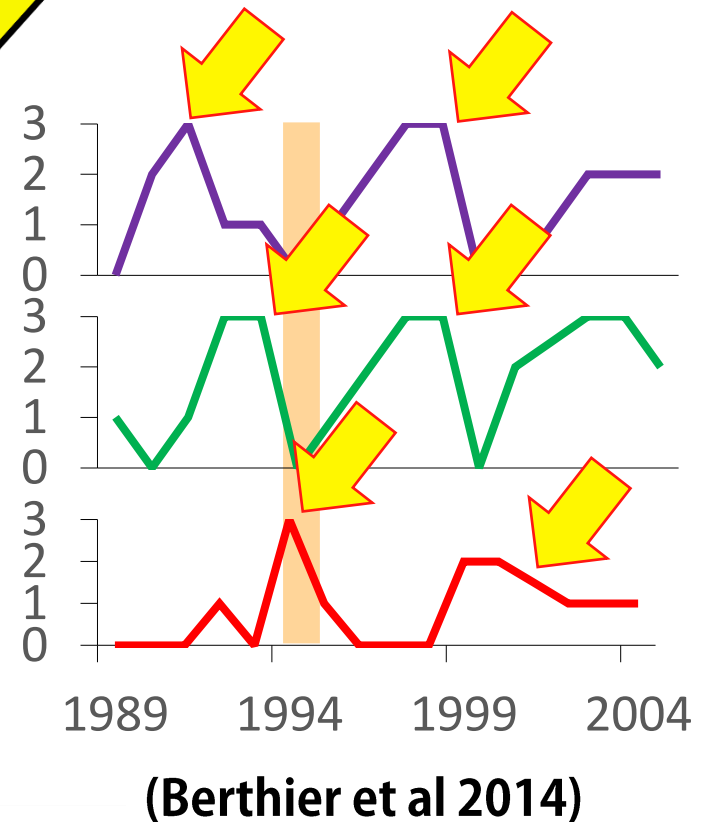
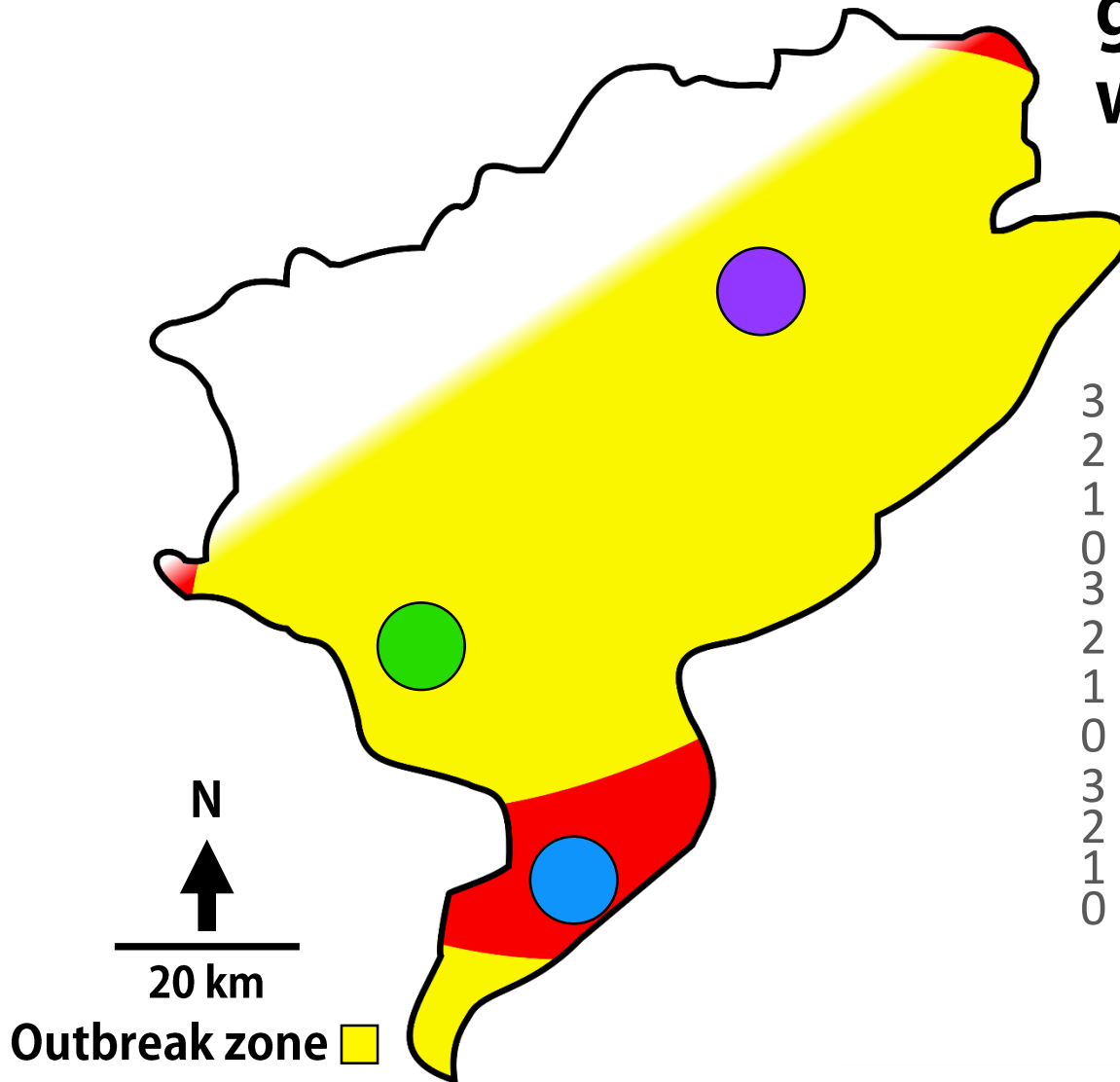
Lagged synchrony  
generates travelling  
wave



(Berthier et al 2014)

# Spatial Dynamics

Lagged synchrony  
generates travelling  
wave





# Decline hypotheses

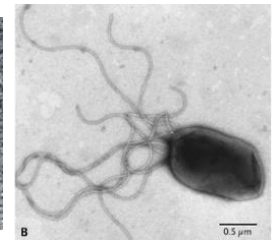
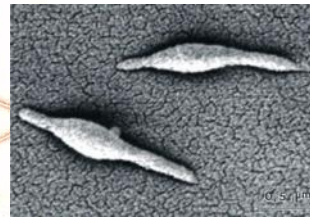
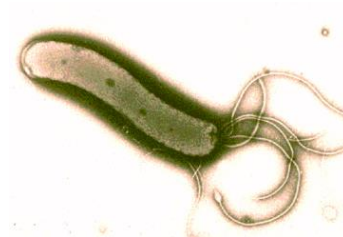
**Predation -**



**Food limitation -**



**Parasites and Diseases -**



# Decline hypotheses

Predation -

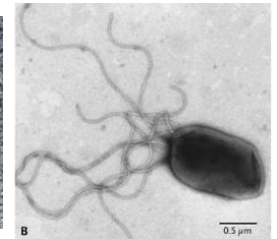
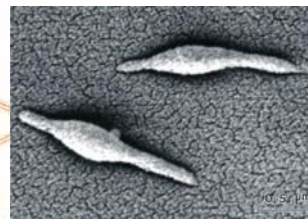
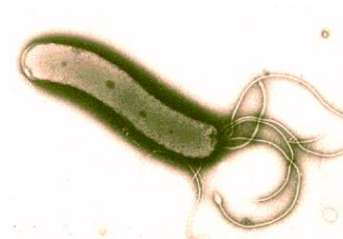


Food limitation -

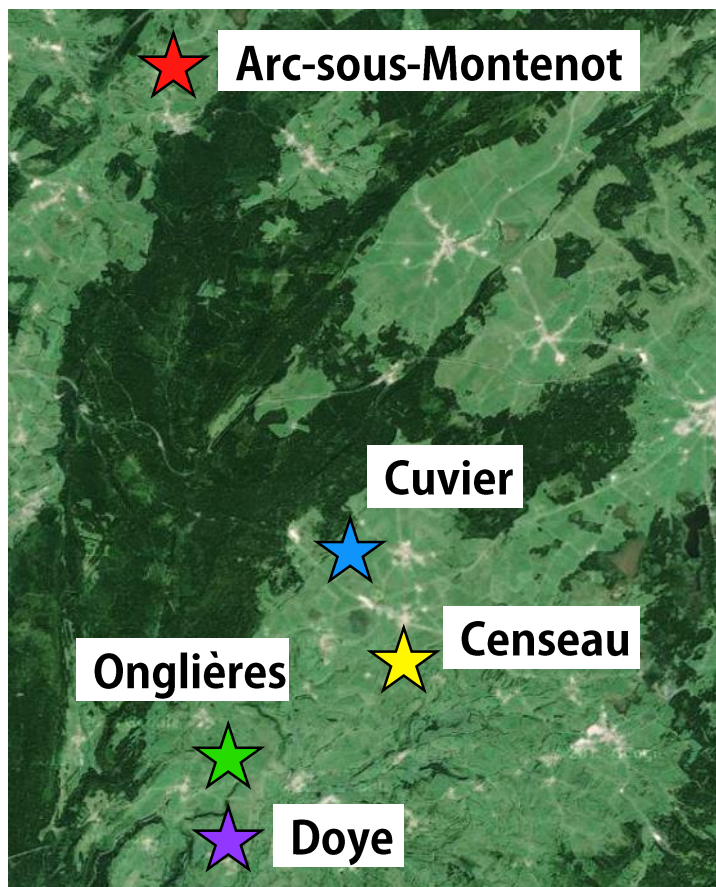


Parasites and Diseases

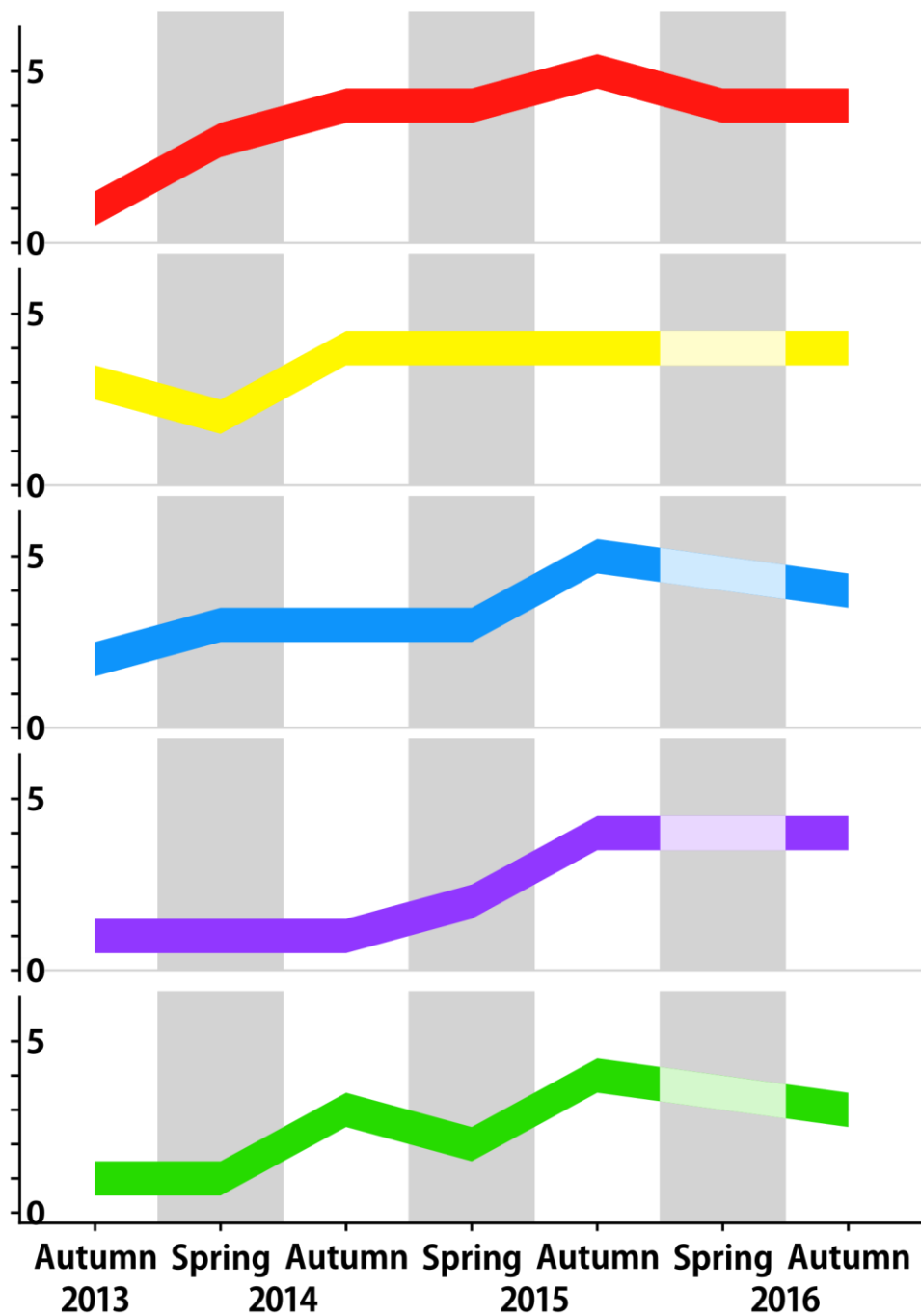
- **Communities**
- **Bacteria**



8 km

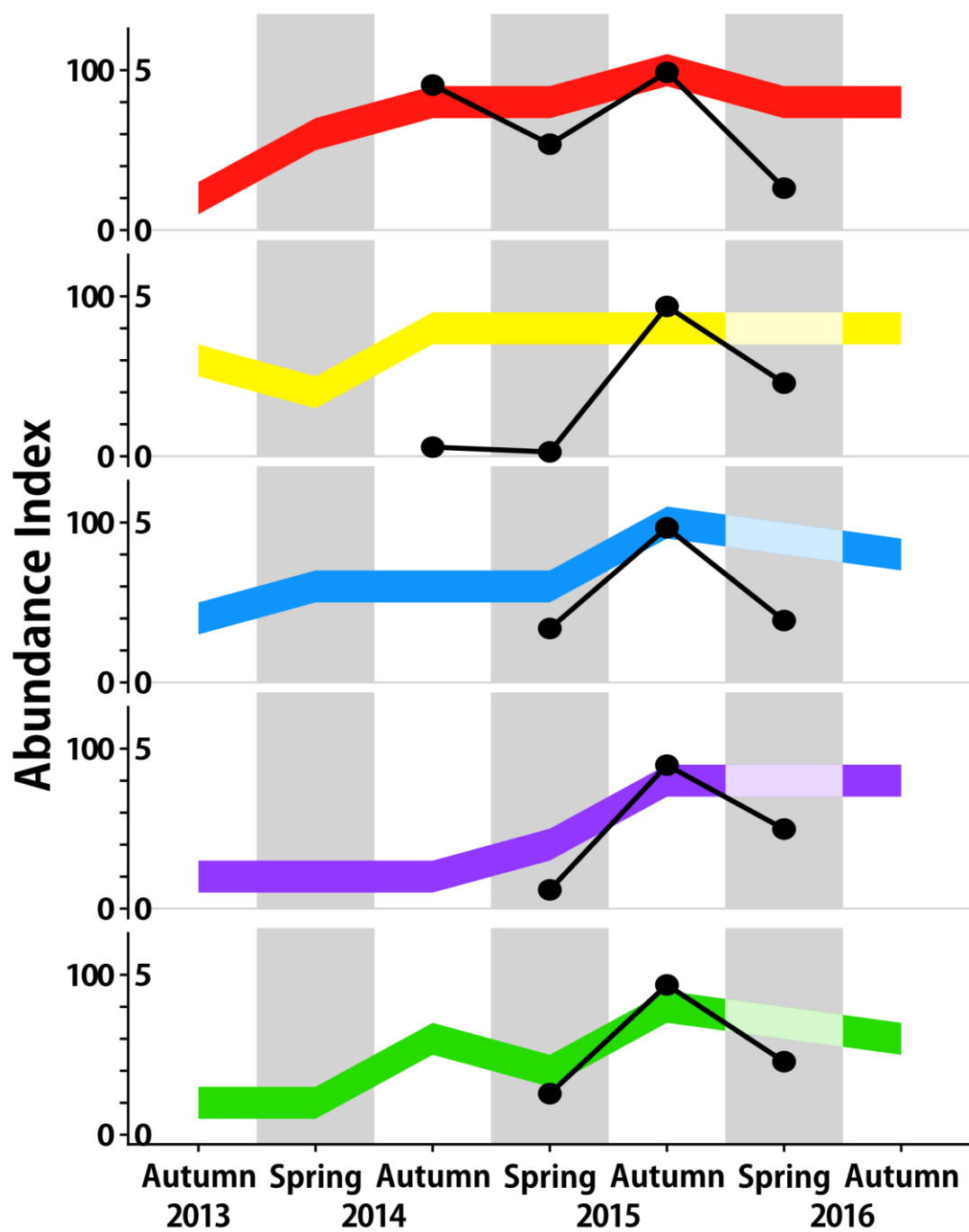
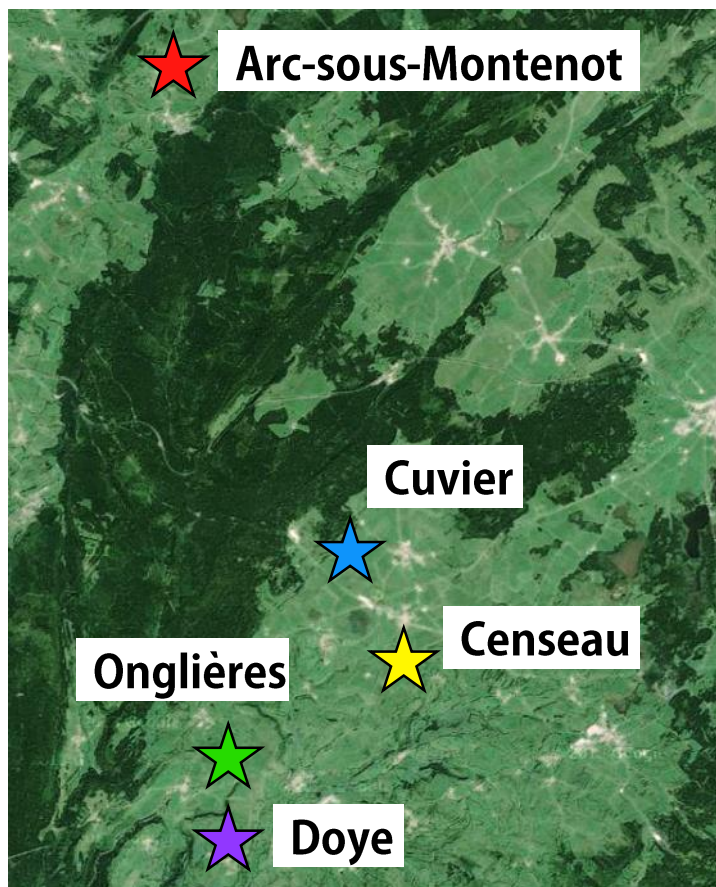


Abundance Index





8 km



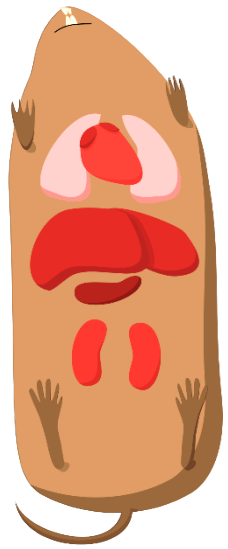




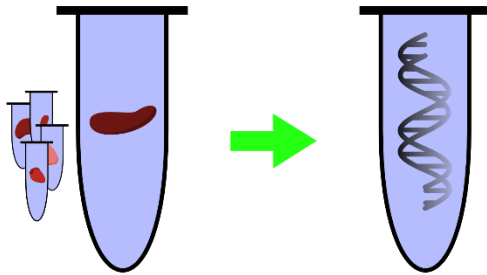




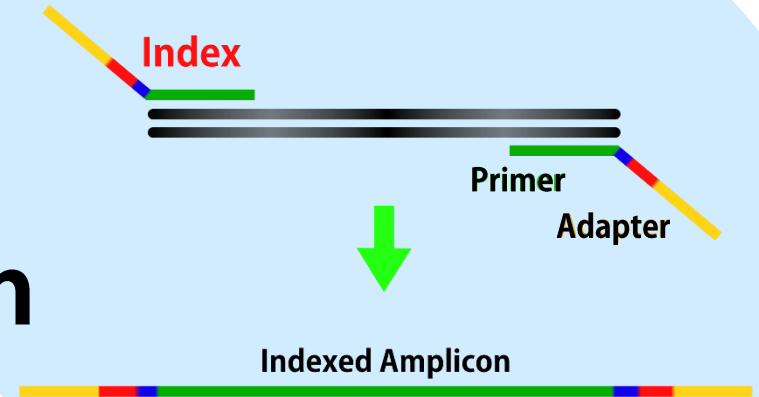




**DNA extraction**

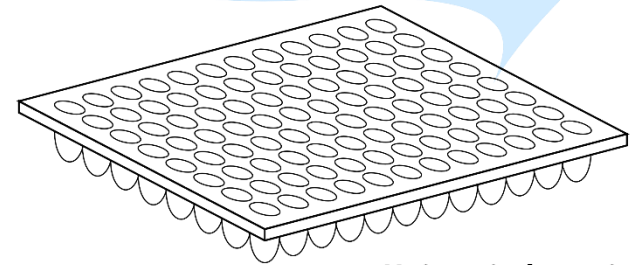
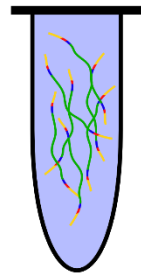


**PCR amplification of V4 region  
of 16s rRNA gene**

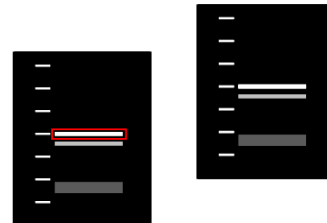


# Next Generation Sequencing

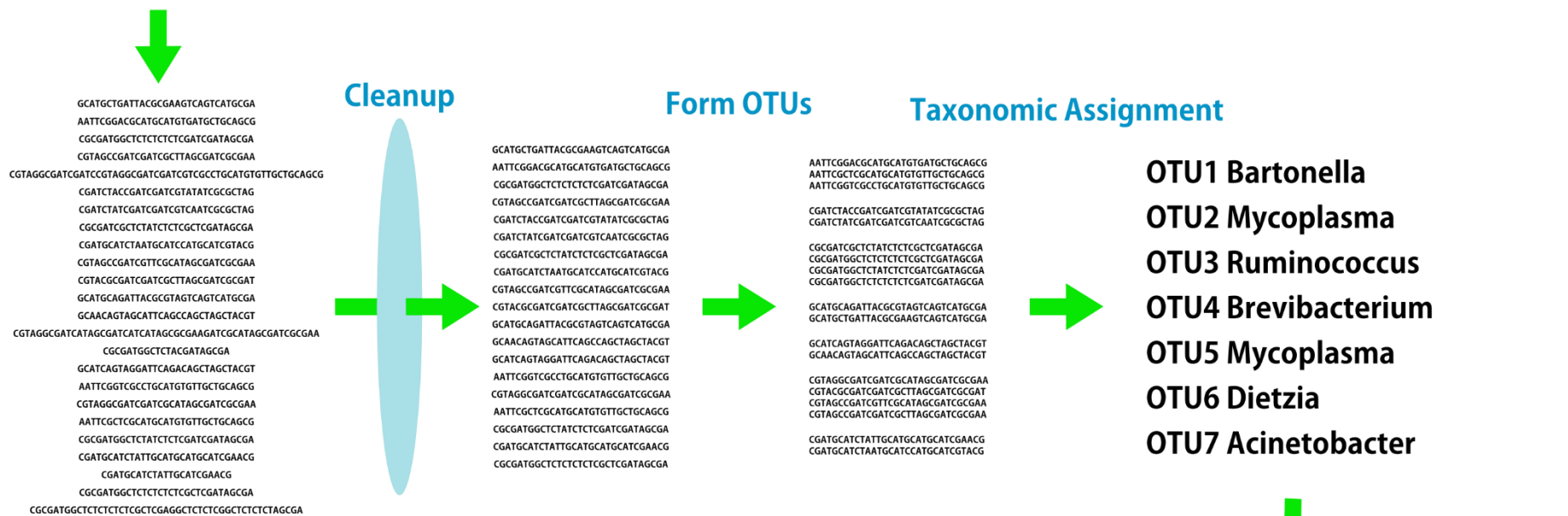
**Pooled amplicons  
sent to sequencer**



**Unique index pairs  
in each well**



**Amplicons pooled, purified**



Reagent contaminant removal  
Cross-contaminant removal  
PCR replicate validation

Gut OTUs

Environmental OTUs



OTU6 Dietzia

OTU3 Ruminococcus

OTU4 Brevibacterium  
OTU7 Acinetobacter

Parasites

OTU1 Bartonella  
OTU2 Mycoplasma  
OTU5 Mycoplasma

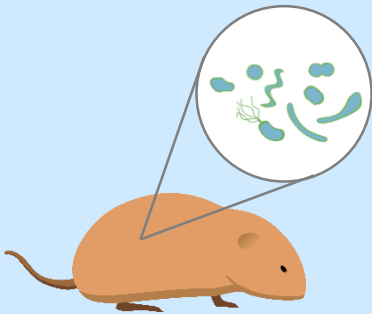
		
OTU1 Bartonella	0	1
OTU2 Mycoplasma	1	1
OTU5 Mycoplasma	0	0

Survival, reproduction outside host limited  
May or may not cause disease

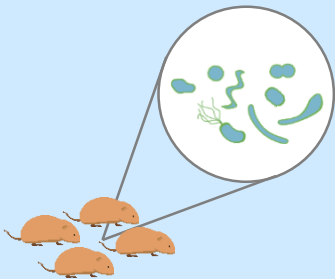
# Peak Phase: Bacterial Parasite Richness Bacterial Parasite Community Similarity

## Scales

### Infracommunity



### Component Community



## Intrinsic Factors

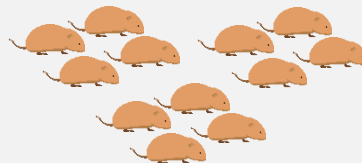
### Age Class



### Sex



### Abundance (Local, Commune)



## Extrinsic Factors

### Location



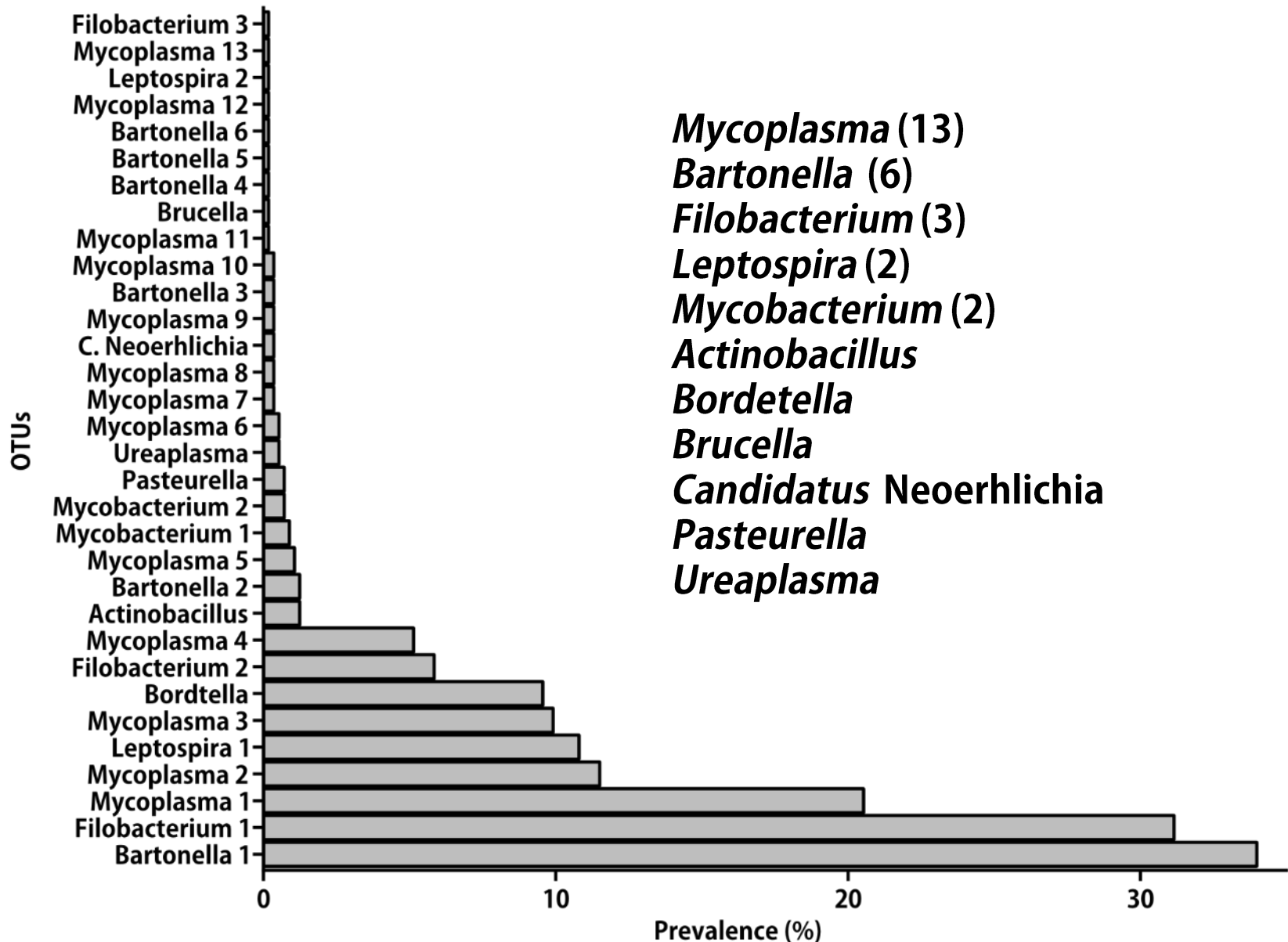
### Date (Season, Year)



2014 2015 2016



# Bacteria

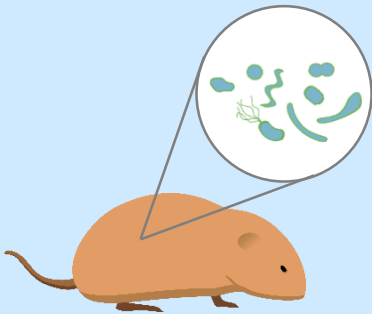


# Questions:

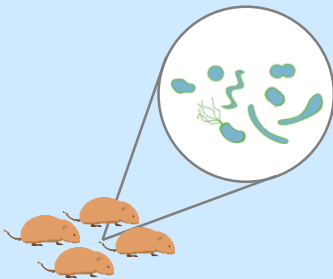
Parasite Richness  
Parasite Community Similarity

## Scales

### Infracommunity



### Component Community



## Intrinsic Factors

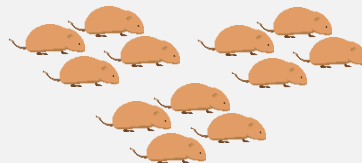
### Age Class



### Sex



### Abundance (Local, Commune)



## Extrinsic Factors

### Location

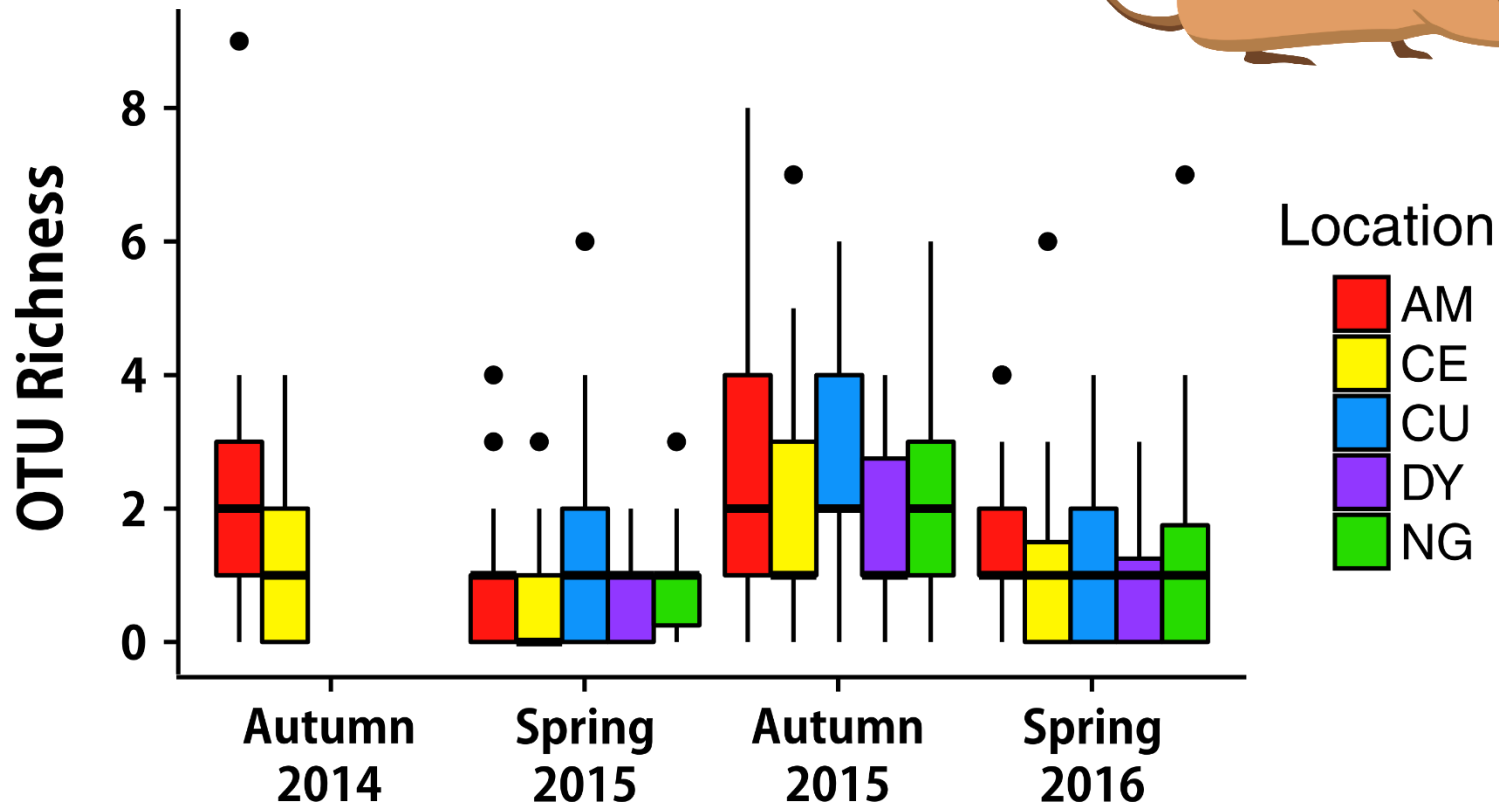
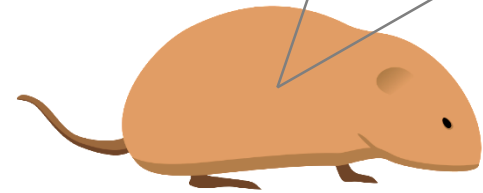
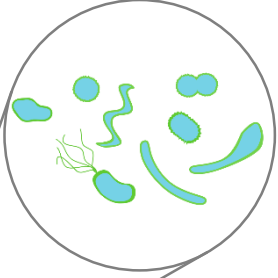


### Date (Season, Year)



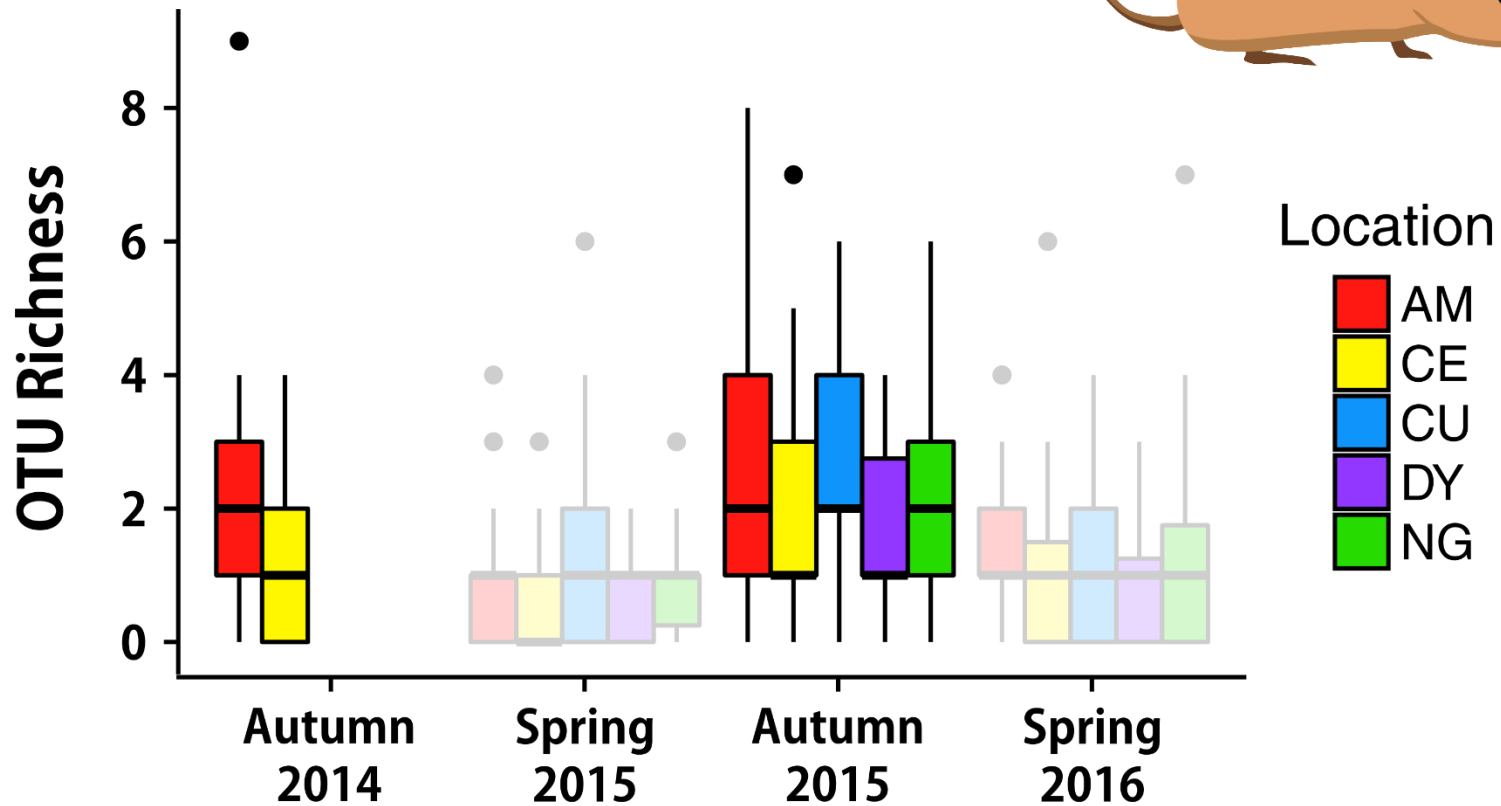
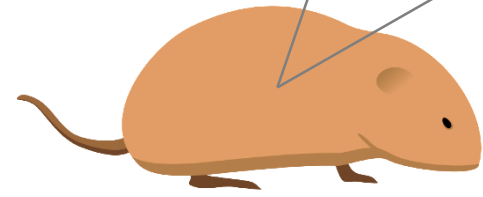
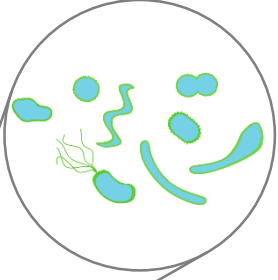
2014 2015 2016

# Infracommunity richness



Zero-inflated Poisson Regression, AIC model selection

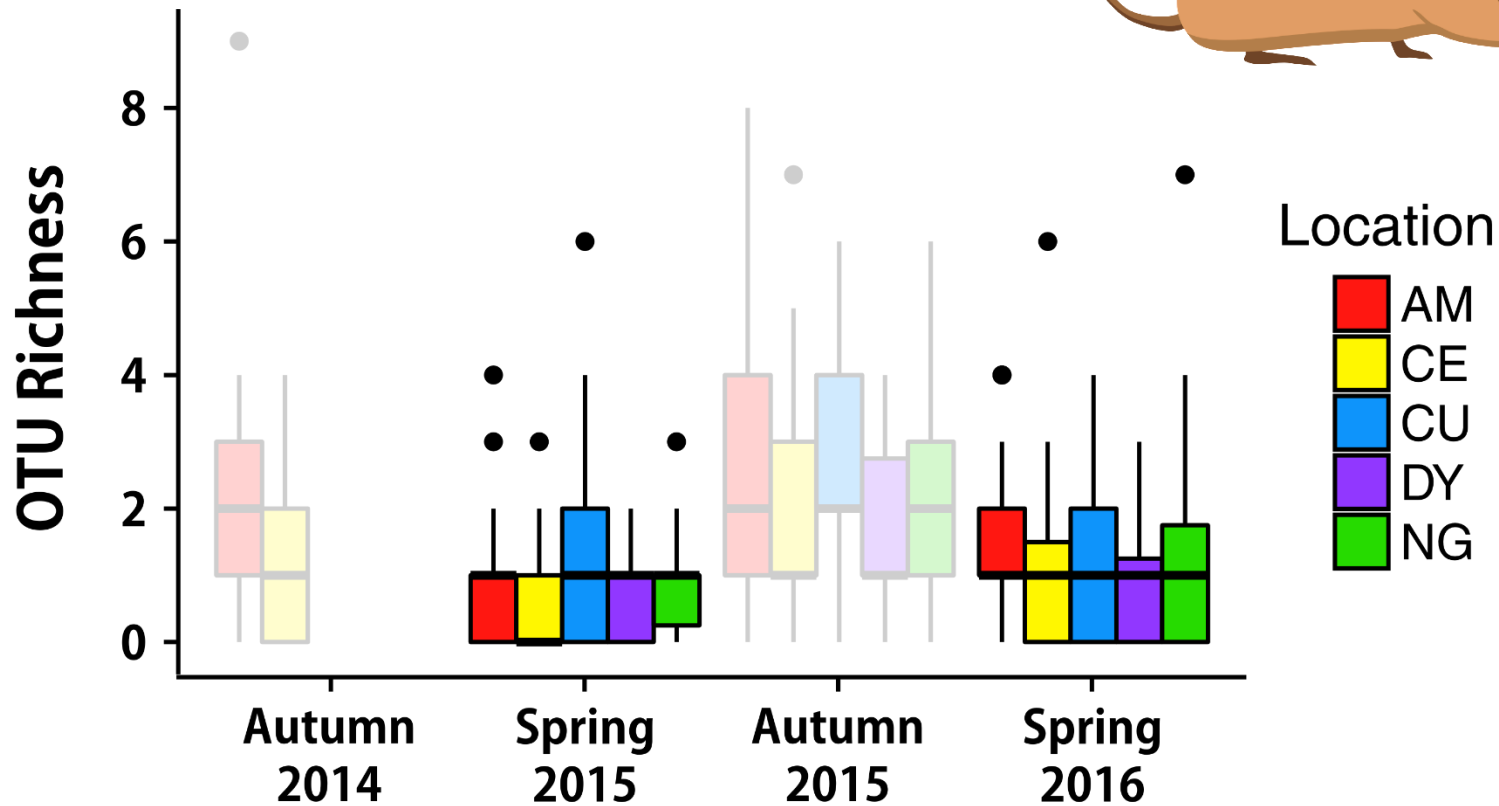
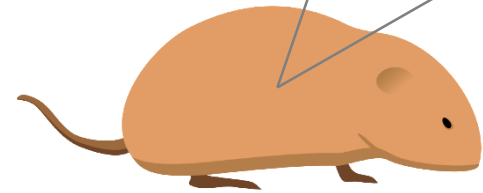
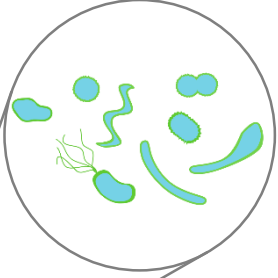
# Infracommunity richness



Zero-inflated Poisson Regression, AIC model selection

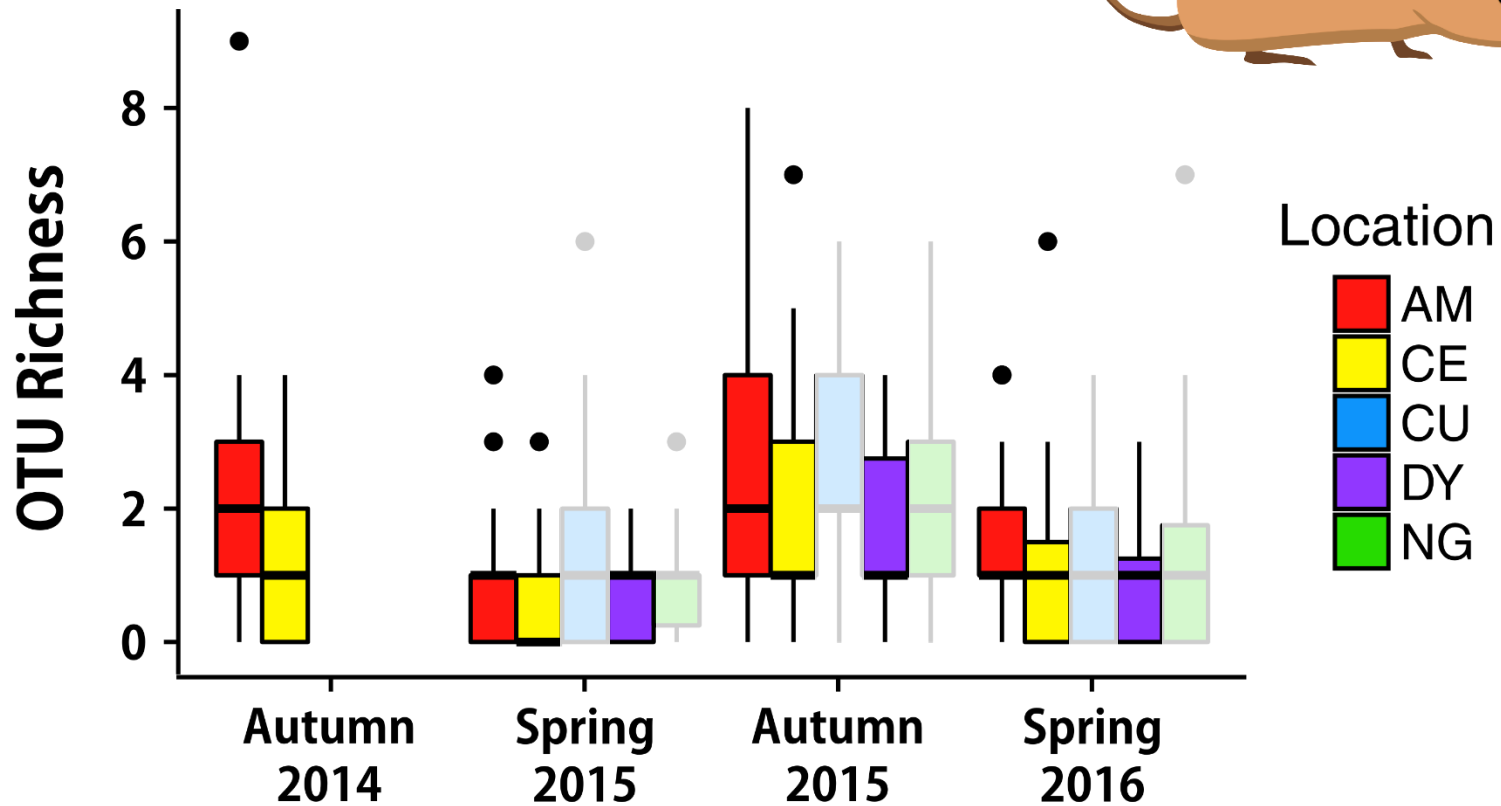
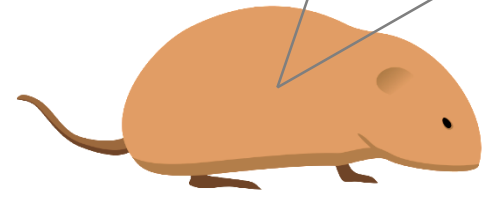
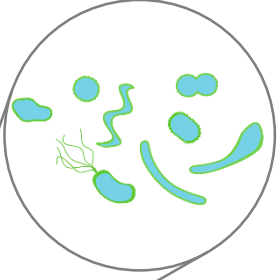


# Infracommunity richness



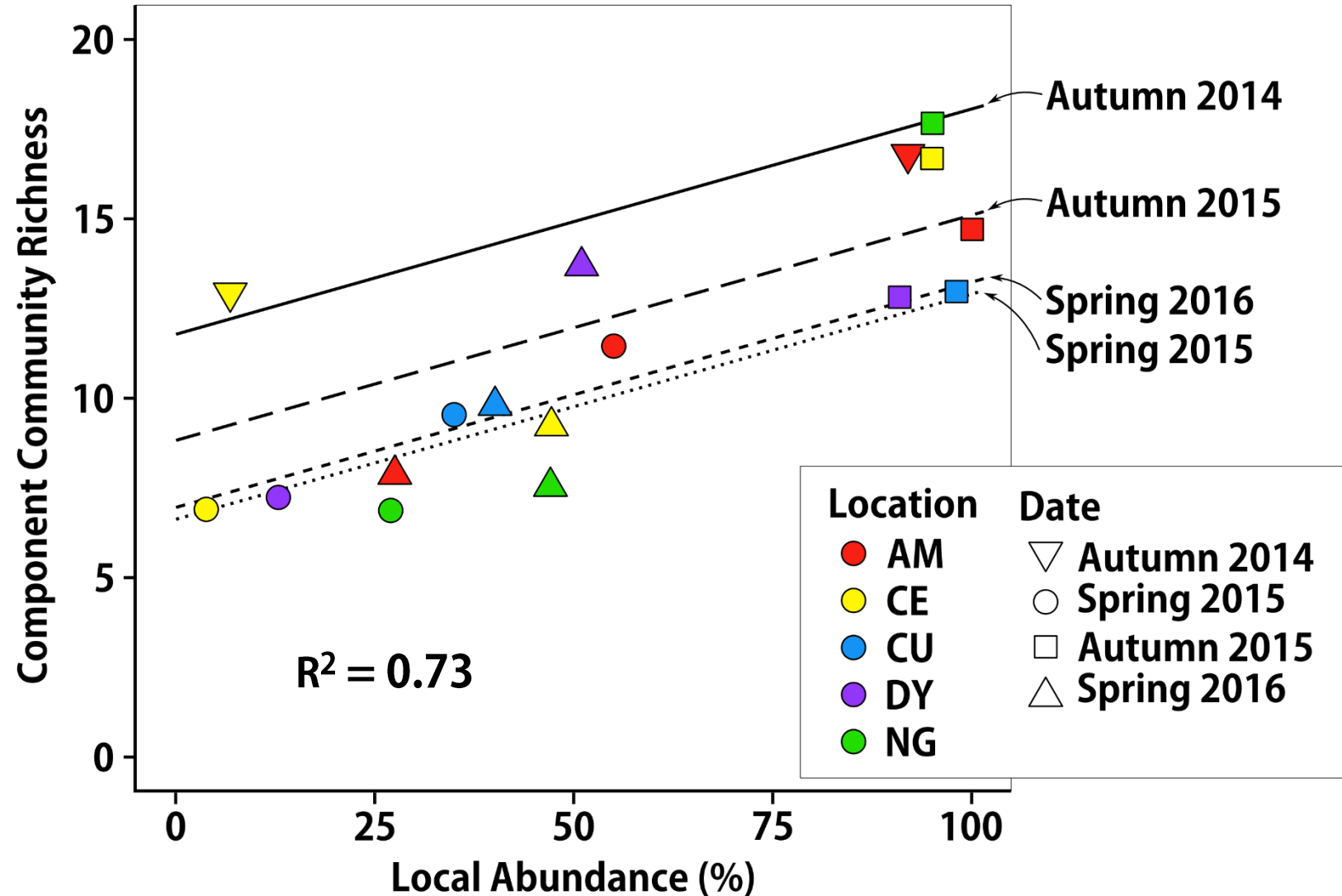
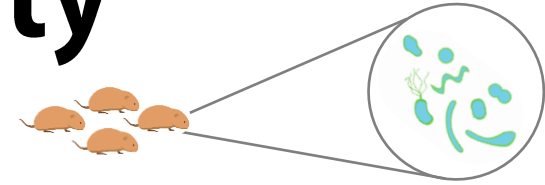
Zero-inflated Poisson Regression, AIC model selection

# Infracommunity richness



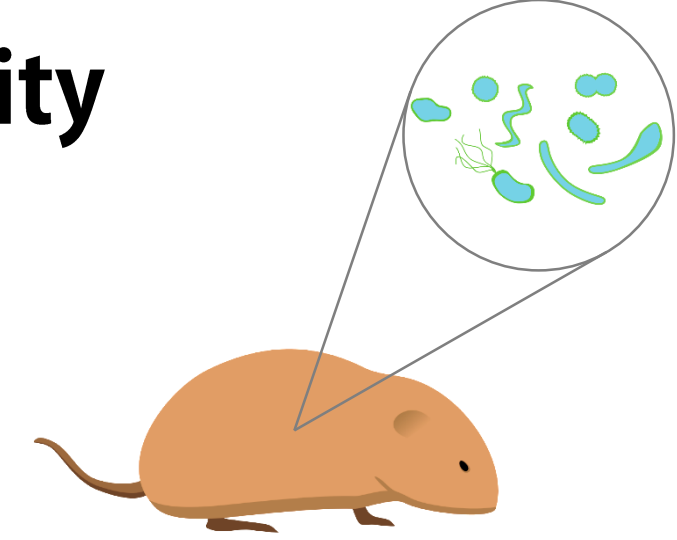
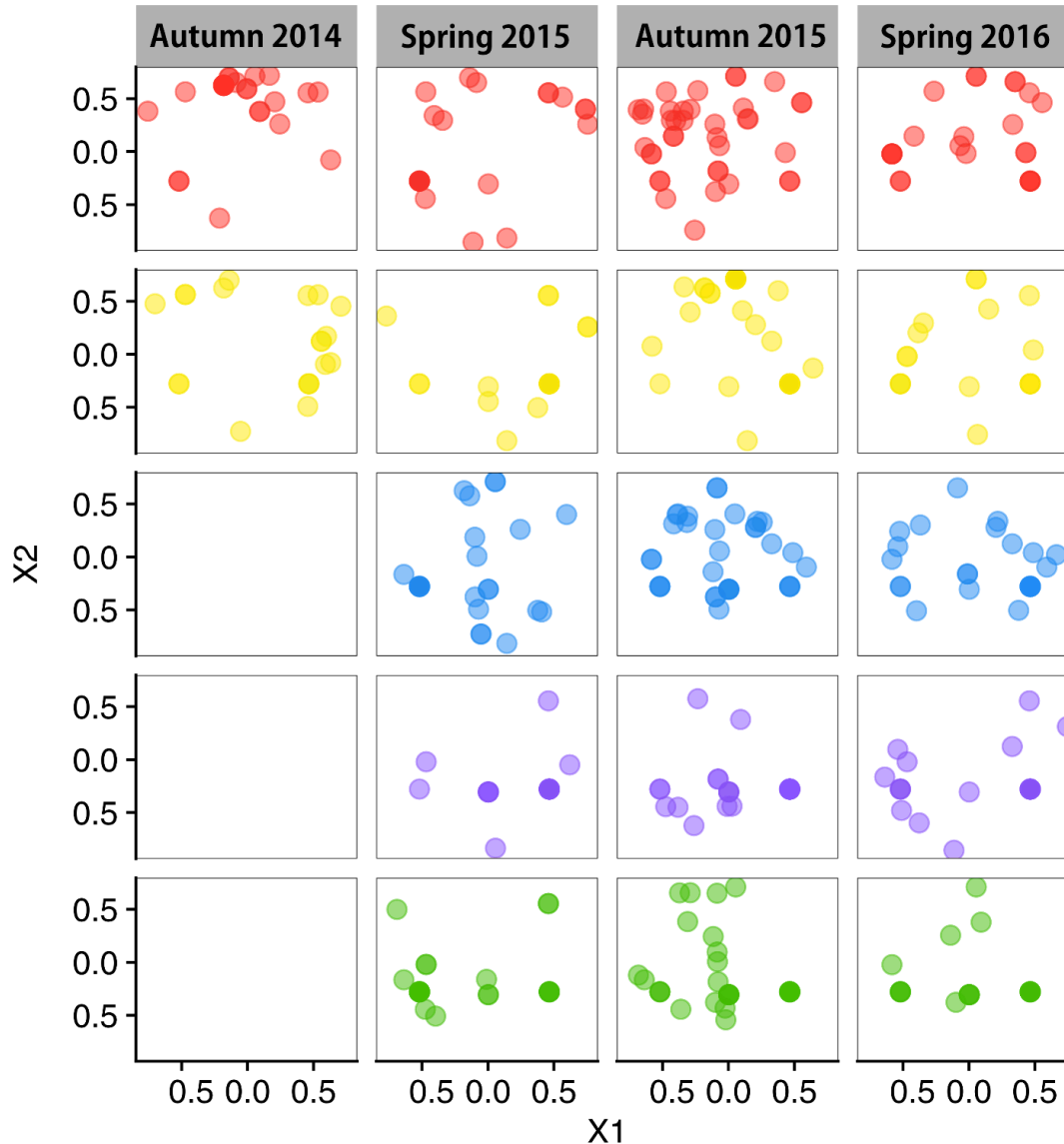
Zero-inflated Poisson Regression, AIC model selection

# Component Community richness



GLM, AIC model selection

# Infracommunity Similarity



## Location

- AM
- CE
- CU
- DY
- NG

## PERMANOVA

**Location - 3%**

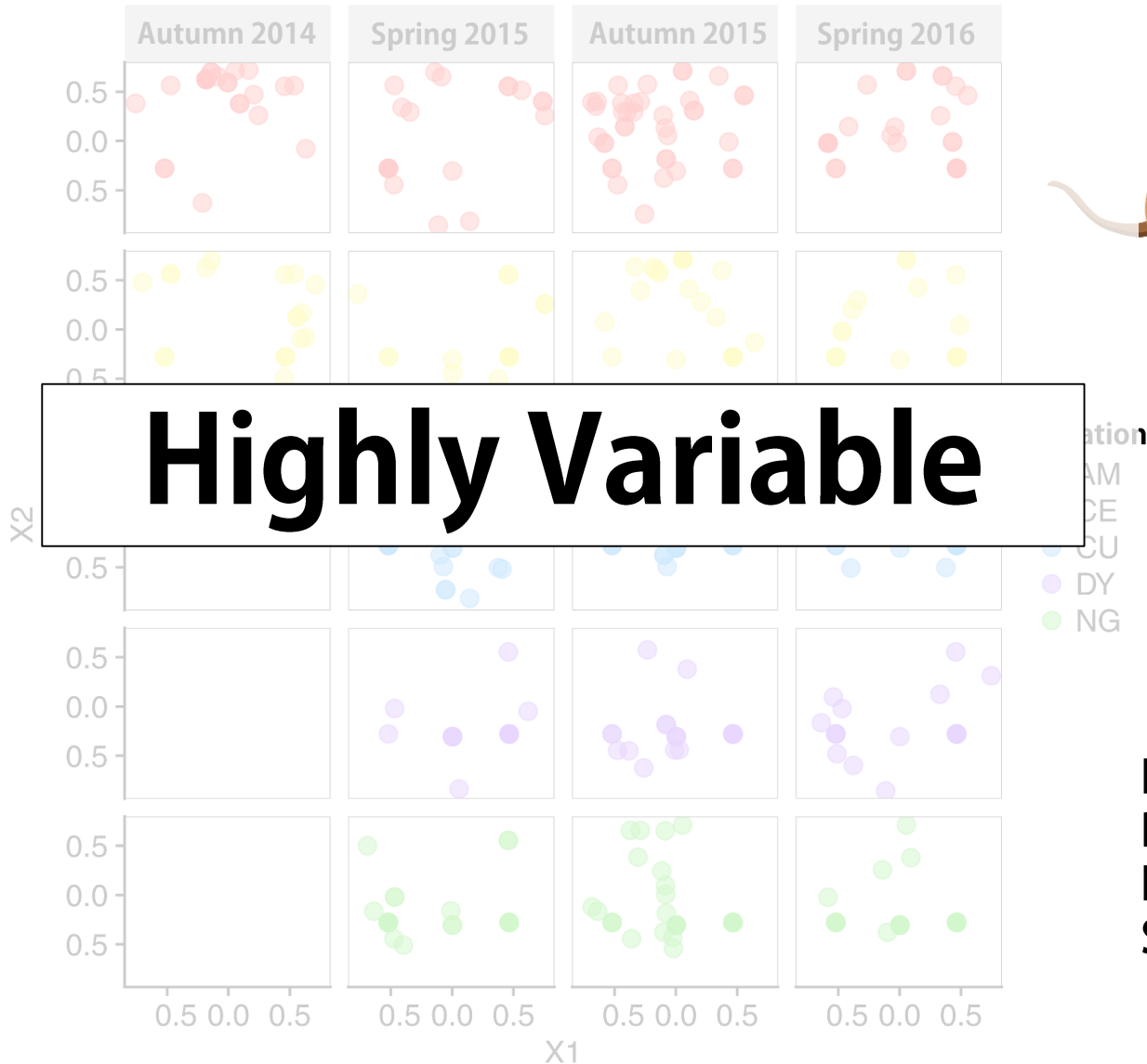
**Date - 3%**

**Local abundance - 2%**

**Sex - 1%**



# Infracommunity Similarity



# Component Community Similarity



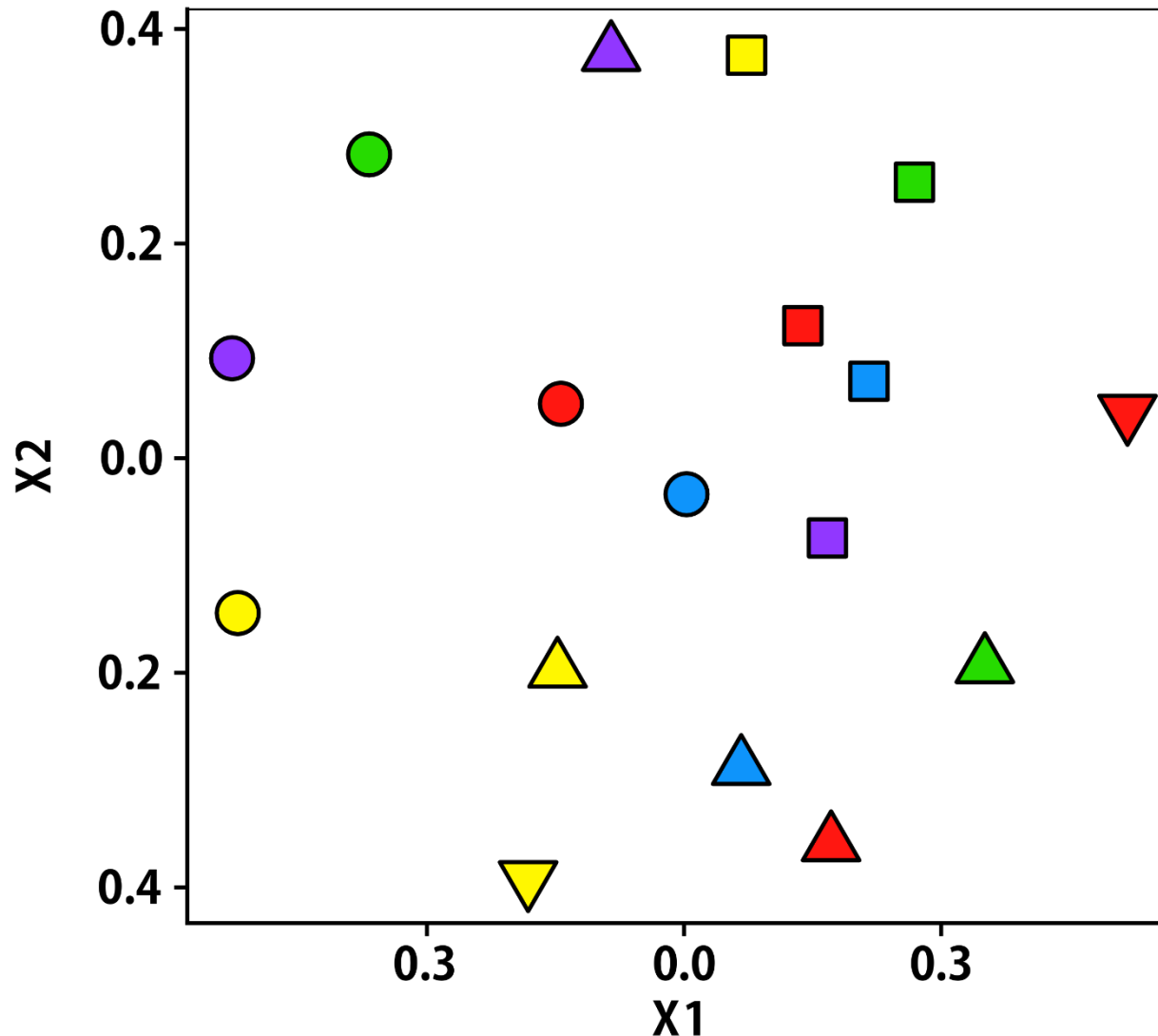
**Date**

- ▽ Autumn 2014
- Spring 2015
- Autumn 2015
- △ Spring 2016

**Location**

- AM
- CE
- CU
- DY
- NG

PERMANOVA



# Component Community Similarity



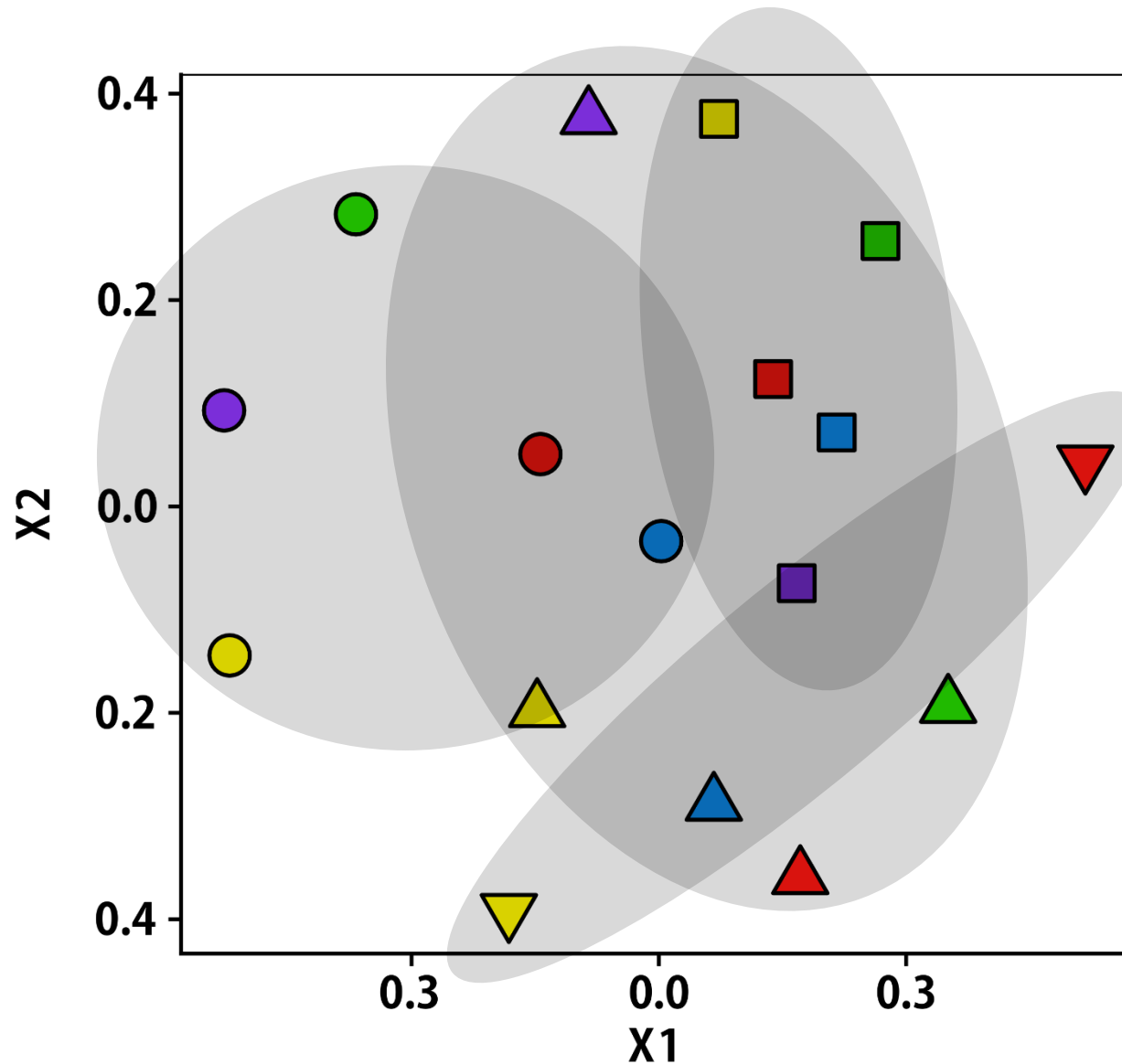
**Date - 25%**

- ▽ Autumn 2014
- Spring 2015
- Autumn 2015
- △ Spring 2016

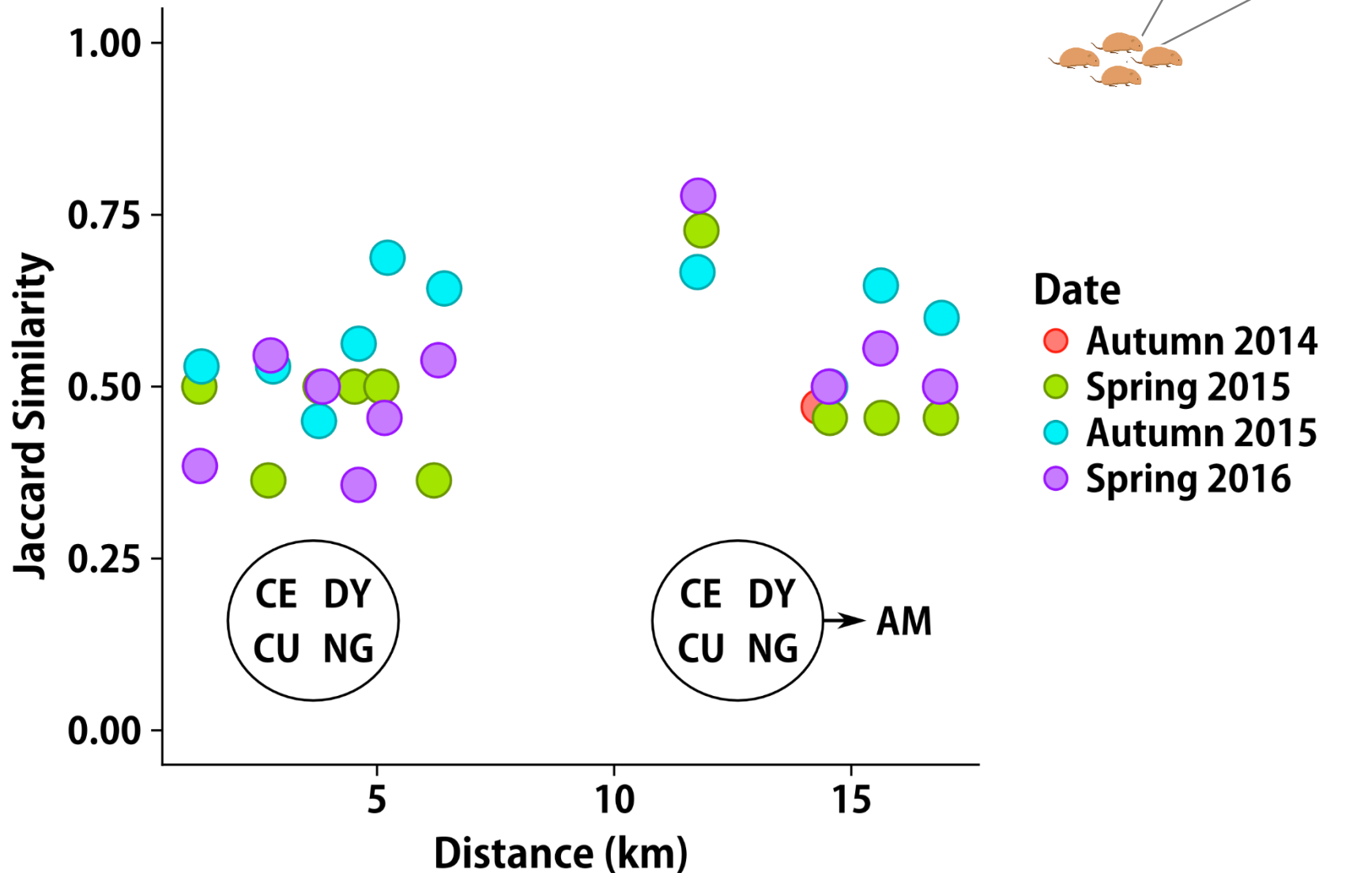
**Location**

- AM
- CE
- CU
- DY
- NG

PERMANOVA

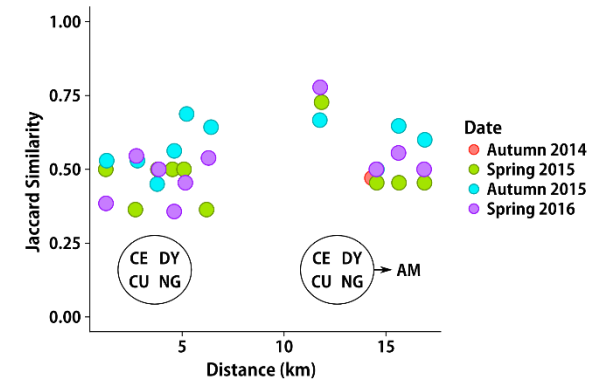
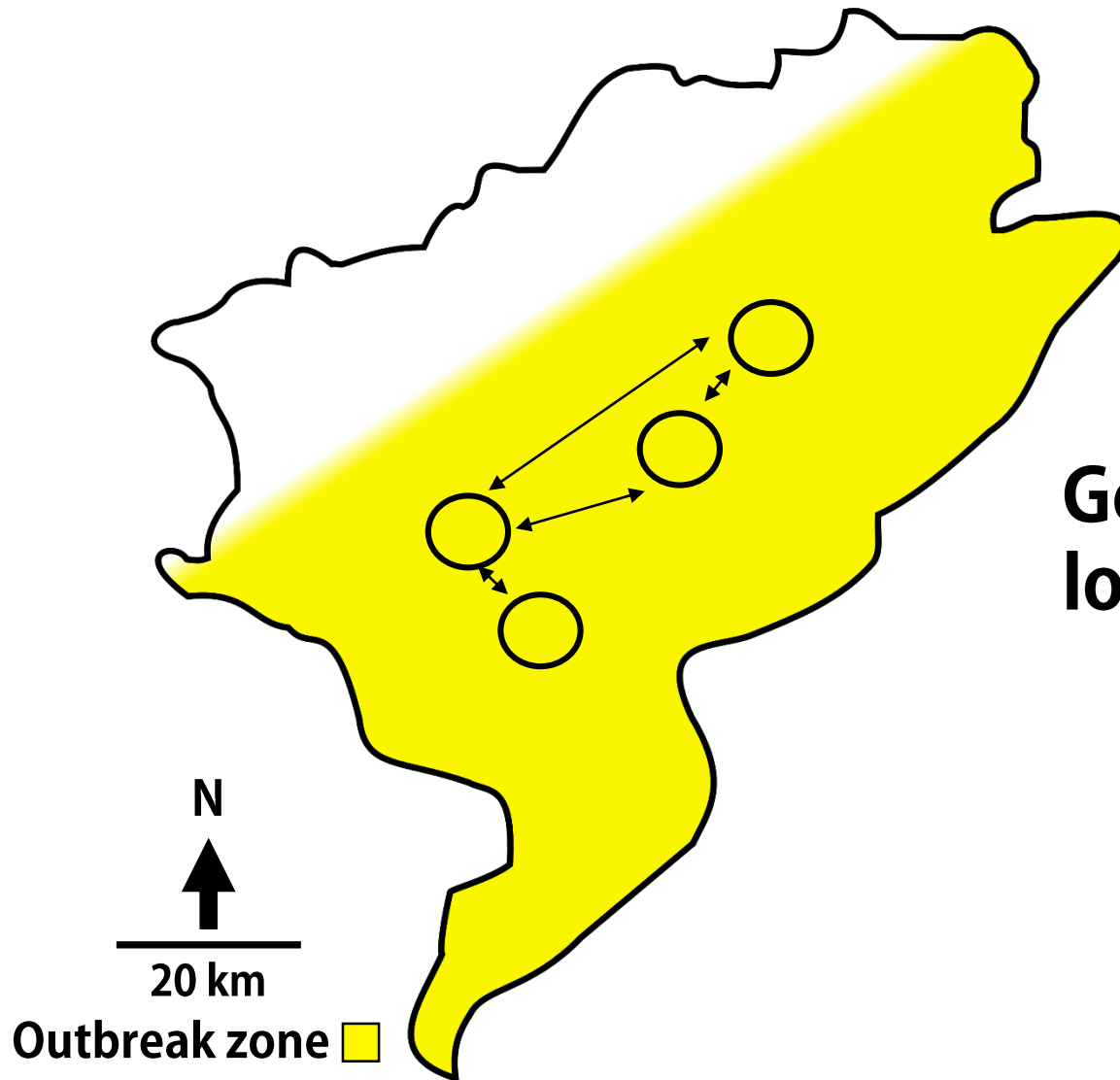


# Geographic Distance





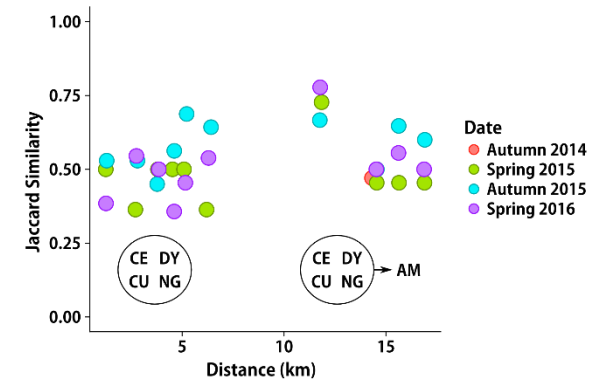
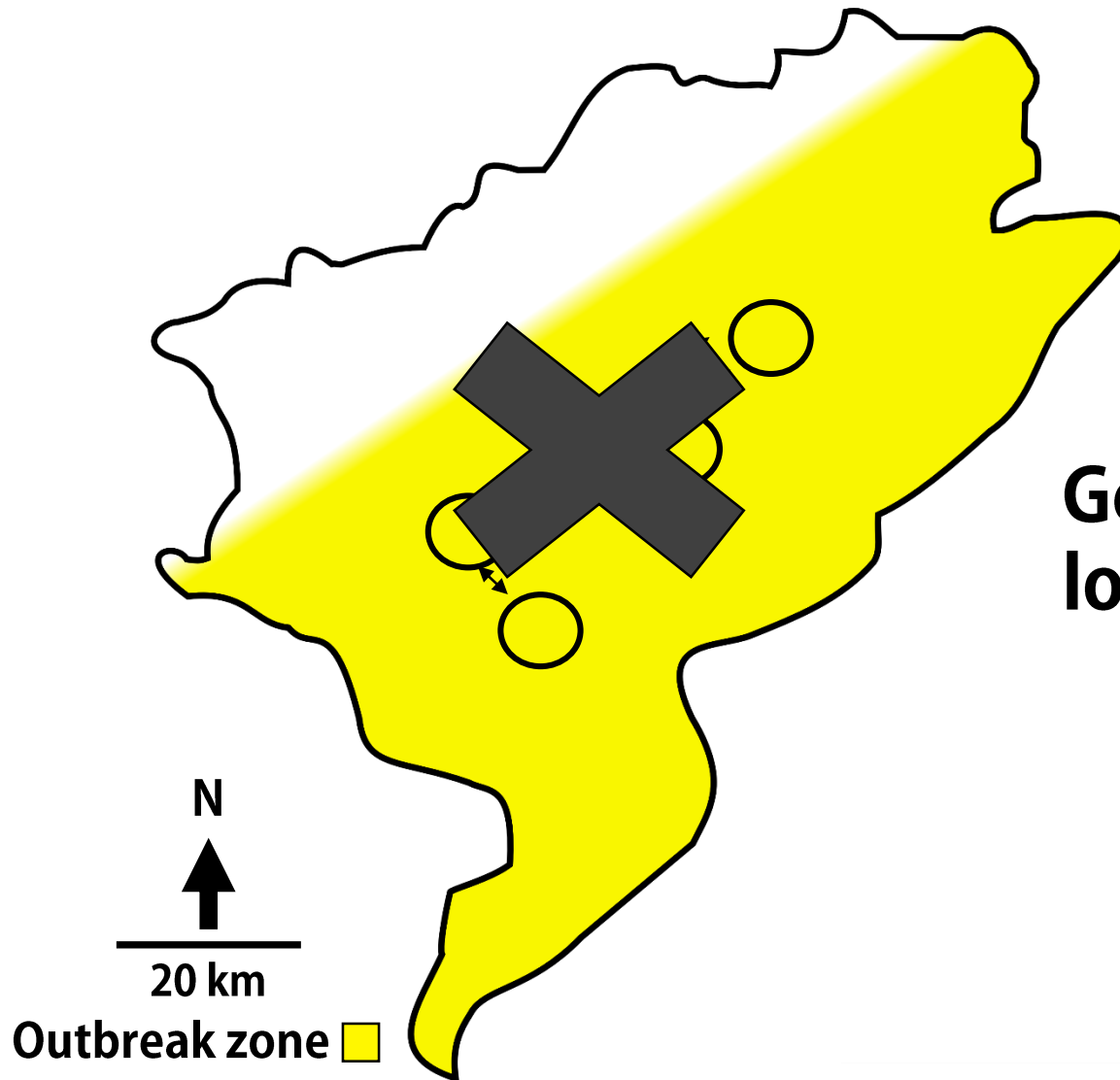
# Geographic Distance



**Gene flow low at  
low density**

(Berthier et al 2005, 2006)

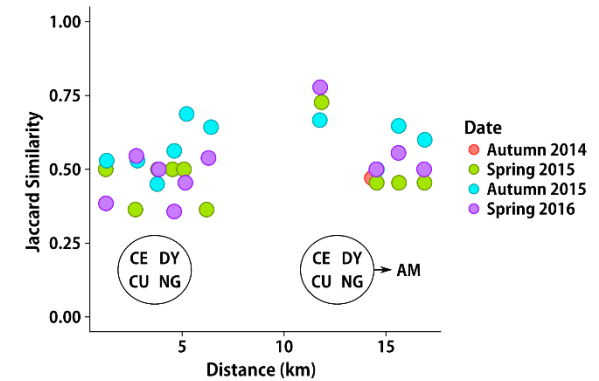
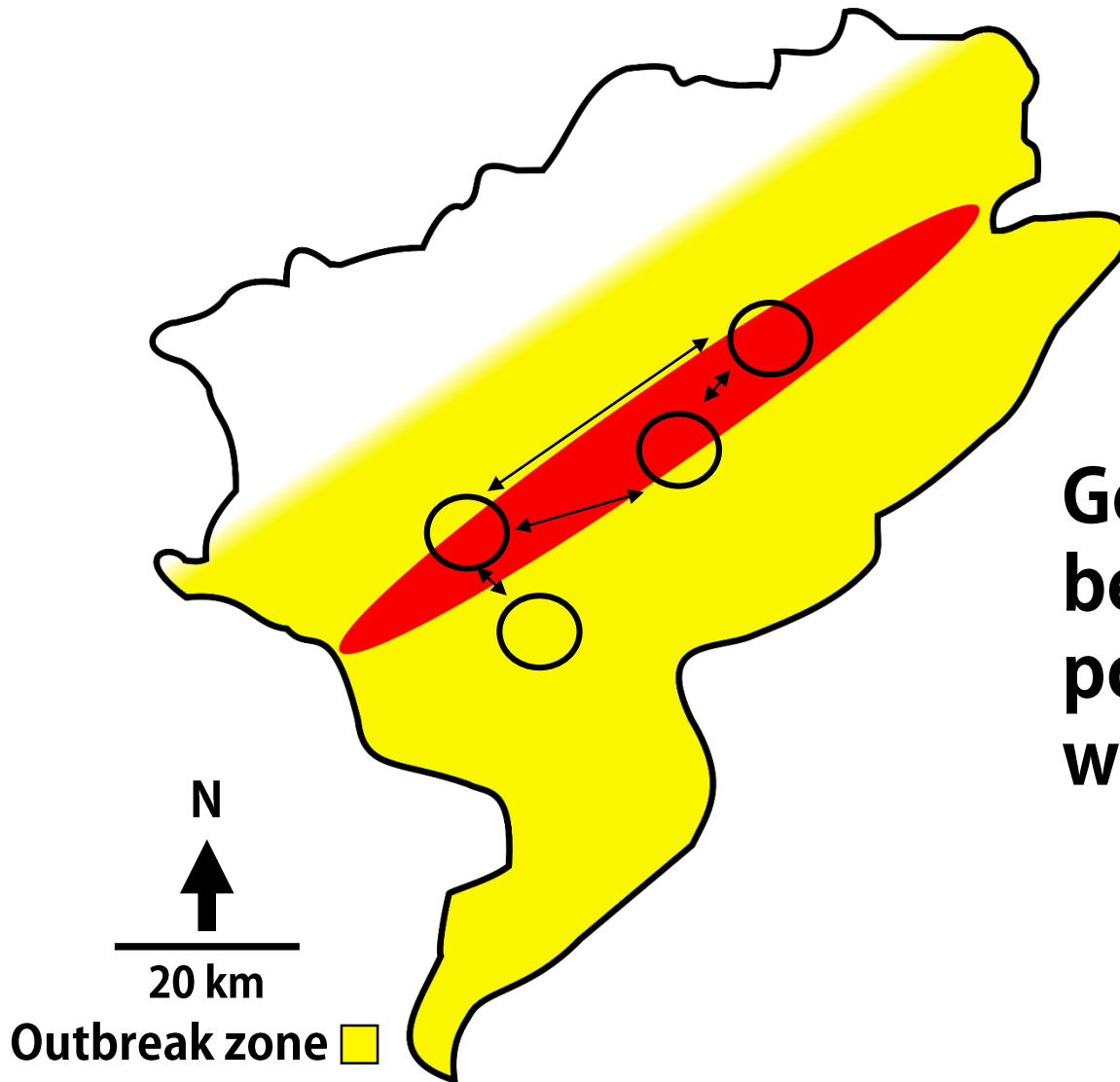
# Geographic Distance



**Gene flow low at low density**

(Berthier et al 2005, 2006)

# Geographic Distance



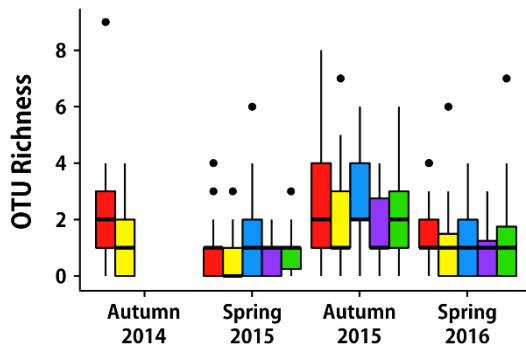
**Gene flow high  
between peak  
populations, decays  
with distance**

(Berthier et al 2005, 2006)

# Summary

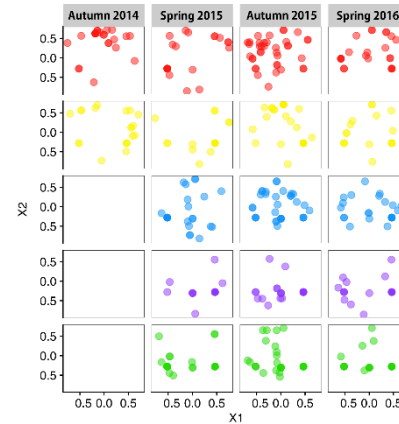
## Richness

### Location, Date

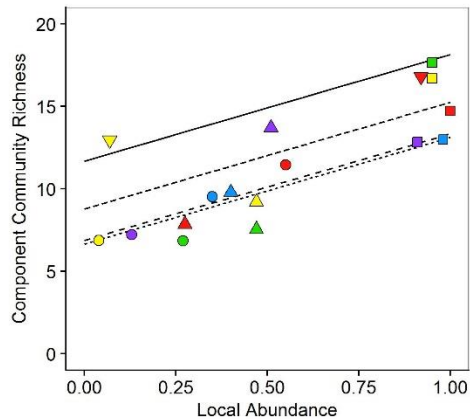


## Community Similarity

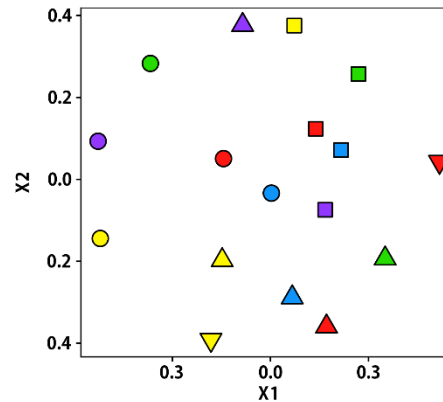
### Highly Variable



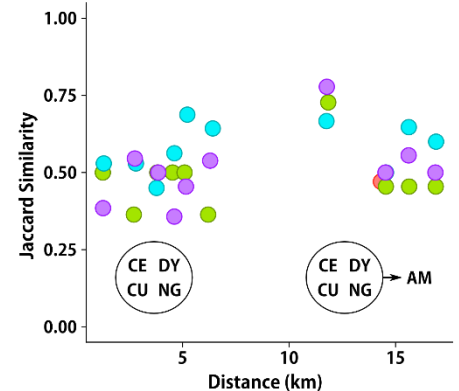
### Local Abundance, Date



### Date



### Geographic Distance





# Thanks for all the help!

- Amaël Dupaix
- Aurélie Guislain-Vitek
- Aurélien Levret
- Bérangère Foscarin
- Caroline Tatar
- Dominique Rieffel
- Eve Afonso
- Geoffroy Couval
- Herminie Piernavieja
- Javier Fernandez-de-Simon
- Jean-Baptiste Pons
- Jean-Francois Cosson
- José Gonzalo Zapata Carbonell
- Julie Montas
- Lexa Villette
- Marilyne Fontanier
- Maxime Galan
- Nathalie Charbonnel
- Nicolas Bassin
- Patrick Giraudoux
- Thibault Moulin
- Virgile Baudrot
- Vincent Driget



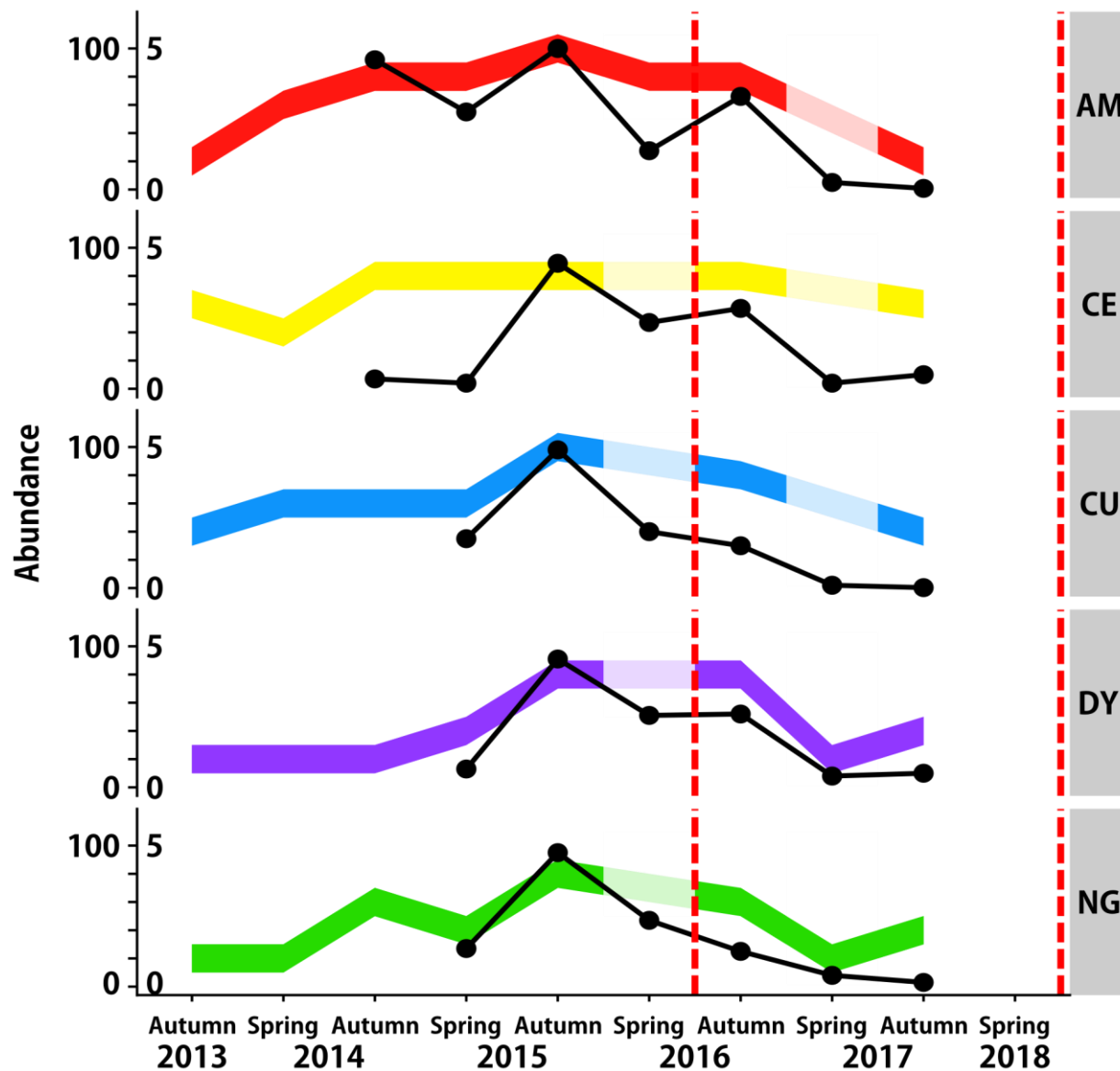
# Merci!



RÉGION  
BOURGOGNE  
FRANCHE  
COMTÉ



# Future Directions - Decline



What happens after  
spring 2016?

Richness

Community  
Composition